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Onion production and varietal improvement studies to meet domestic and export market requirements

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Queensland Horticulture Institute

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Horticulture Australia

Final Report

Horticultural Research and Development Corporation

Onion Production and Varietal Improvement Studies to meet Domestic and Export Market Requirements

Project No. VG 95030

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Queensland Fruit and Vegetable Growers

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1. Media Summary

The types of onions grown in Queensland are short day, salad onions with mild pungency. They can be grown from late February through to June. This spread of planting dates requires numerous varieties to meet the changing climatic conditions. Onion growth and development is highly sensitive to changing temperature and daylength.

Four variety trials were established at monthly intervals commencing in March and continuing until mid June in each of the three years of evaluation. Between 50 and 65 varieties were tested throughout 1996, 1997 and 1998. Commercial seed companies (SPS, Henderson's, Yates, Magnus Kahl, Sandoz, New World and Lefroy Valley East) as well as four local seed growers (Neuendorf, Litzow, Else and Schulz) and Gatton Research Station supplied seed of various varieties for testing. Varieties tested can be grouped into early season varieties (March planting), mid season varieties (April and May plantings) and late season varieties (June planting).

The trials revealed that the local varieties maintained by local seed growers were the best adapted varieties for the early to mid season plantings. Golden Brown was the outstanding variety in this category as it can be used for both domestic and export markets. For mid season plantings, Golden Brown and Wallon Brown (an early selection of Gladalan Brown developed at Gatton Research Station) were the best of the local varieties. A number of potential hybrids including Yates' Cavalier and Predator, South Pacific Seeds Rio Xena and Henderson's Sombrero were identified for this production period. In the late season planting, the varieties Colossus (Yates) and experimental line 1378 (South Pacific Seeds) have potential on the domestic and export markets. The storage quality of the late season lines was superior to the earlier season lines and the skin retention and colour of these later varieties was also generally superior to the earlier varieties.

Up to ten jumbo onion varieties were tested from 1996 to 1998. Planting methods and differing plant spacings had no significant effect on the yield of jumbo onions. The best yield of large onions (125-150mm) was obtained from 150mm spacing. In 1998 two jumbo varieties and a number of nitrogen applications formed the basis of an investigation into the influence of nitrogen rates and application times on the growth of jumbo onions. Increasing rates of nitrogen and timing had no effect on bulb size or final yields. Future work should involve identifying superior varieties with a consistent size range.

2. Technical Summary

This project was instigated by the Heavy Produce Committee of the Queensland Fruit and Vegetable Growers because of concerns with the available onion varieties to meet the demands of domestic and export markets. The project is a continuation of the project VG530 "Evaluation and Development of Onion Varieties for Domestic and Export Markets". Particular concern had arisen about the greening of Early Lockyer White onions and the poor skin retention of local lines which detracted from their export potential. Another concern was the lack of information of the correct planting date for potential new varieties and a lack of information regarding jumbo onions.

The Queensland onion industry is primarily located in the Lockyer Valley in SE Queensland where plantings take place over an extended period (from late February to mid June). Because onion growth and development is highly sensitive to climatic changes especially temperature and daylength, a suite of varieties is required to meet the changing climatic conditions during the spread of planting dates. Investigations into the availability of new varieties for Queensland growing conditions were carried out from 1996 to 1998. Trials were planted at monthly intervals commencing in March and ceasing in June. A total of 50 cultivars in 1996, 62 cultivars in 1997 and 55 cultivars in 1998 were evaluated. Four and ten jumbo onion varieties were tested in 1996 and 1997 respectively. Two jumbo varieties were tested with a number of nitrogen application times and rates in the 1998 trial. Seven seed companies (South Pacific Seeds, Yates, New World, Henderson's Seeds, Magnus Kahl Seeds, Sandoz and Lefroy Valley East), four local seed growers (Neuendorf, Litzow, Else and Schulz) and Gatton Research Station supplied seed of various varieties for testing.

In each of the three years of variety trials different methods of planting were used. Year 1 saw the use of a cone planter. This method resulted in irregular spacing between plants and the need for extensive thinning of the trials. Transplants were used in 1997. This resulted in excellent plant spacing and accurate populations, but plant growth was unsatisfactory due to the excessive growth in the nursery. Hybrid varieties also out-performed the open-pollinated varieties. An air seeder was used in year three. This method proved to be the most successful by overcoming the shortcomings of the other methods. Some thinning was still necessary but the evenness of plant spacing was very good.

Each planting of the variety trials consisted of three replicates of the nominated entries. After establishment through direct seeding in 1996 and 1998, plots were hand-thinned to establish commercial populations. At maturity detailed recordings were made on yield characteristics, percentages of seed heads, doubles and off types, bulb characteristics including shape, skin colour and skin retention as well as storage potential. The latter characteristic was determined after 12 weeks storage.

The majority of varieties tested were hybrids. Consequently, there were fewer varieties that produced excessive seed heads compared to trials in the previous project. This was particularly evident in the 1998 trial series although disease and mild weather conditions were a problem during this season.

While this project has identified a new suite of onion varieties (some of which were released onto the commercial market in 1998 and 1999) with potential on the domestic and export markets, ongoing research is required to better identify optimum planting dates and trial assessments for these markets. These aspects are being addressed as part of the objectives of a subsequent project.

Data collected from the jumbo trials indicated that the optimum spacing to produce onions greater than 100mm in diameter is 150mm. The only variety of those tested that has potential as a jumbo onion is the Yates Vegetable Seeds experimental line E511 which has subsequently been released as Colossus. Different rates of either nitrogen or nitrogen application times did not result in an increase in the numbers of jumbo size bulbs (>100mmm diameter).

3. Introduction

This project was a continuation of a project undertaken at the request of the Heavy Produce Committee of the Queensland Fruit and Vegetable Growers to evaluate potential varieties for the domestic and export markets. Commercial seed companies were invited to participate by entering lines that they had identified as having potential in Queensland. These companies also contributed to the funding of the project by paying an entry fee of $100 per variety per planting date in which the variety was entered. Local seed growers were asked to supply seed of their commercial strains so that they could be used as controls. A number of lines developed at Gatton Research Station in the Lockyer Valley were also used as controls.

Production of onions in Queensland is mainly confined to the Lockyer Valley and the Eastern Darling Downs. Annual production for Queensland ranges between 20 000 and 25 000 tonnes; 80% of which occurs in the aforementioned regions. Plantings commence as early as February and continue until June in the Lockyer Valley whereas on the Darling Downs the planting season is much more confined with most plantings taking place in May. The wide range of planting dates in the Lockyer Valley requires the development of a suite of varieties that are adapted to the changing temperatures and daylengths that occur over the planting period as these two climatic variables have a significant influence on onion growth and development. To determine potential varieties, four planting dates at monthly intervals commencing in February and ceasing in June were investigated in 1996, 1997 and 1998 at Gatton Research Station. Investigations into the potential for jumbo onions to be grown in the Lockyer Valley were also undertaken during this time.

The type of onion grown in Queensland is a short day onion that is generally characterised by its milder pungency than the long day onion grown in Southern Australia. The low pungency onion is popular for cooking and as well as for use in salads. A major problem of these mild, salad onions is that they have poor skin retention and short shelf life. Early season, white onions also tend to green an undesirable trait in salad onions. As part of the evaluation, emphasis was placed on identifying brown varieties that had improved skin retention and longer shelf life.

Queensland onions are grown primarily for the domestic market, but small export shipments accounting for approximately 1 000 tonnes are made annually. These exports are to a range of destinations in the Pacific Rim, as well as SE Asian and North Asian countries where there has been a distrint interest in the mild salad type onions produced in Queensland. As part of the assessment conducted in 1996 and 1997, a sample was stored for three months to evaluate varieties that had the storage characteristics to enable export. Sweet onions are also popular in overseas markets therefore sweetness was objectively measured by % brix

The project has been a successful team effort with funding from the Queensland Department of Primary Industries, Horticultural Research and Development Corporation, Heavy Produce Committee of the Queensland Fruit and Vegetable Growers and the seed companies Yates, South Pacific Seeds, Hendersons Seeds, Lefroy Valley East, Magnus Kahl Seeds, Sandoz Seeds and New World. Local seed growers also cooperated by providing control varieties. Field days were held in each of the three years of the project. Results from the trials have also been published annually in 'Onions Australia". The research has indicated that the locally developed varieties are still the best-adapted varieties for early plantings. However, a number of new varieties developed by the seed companies demonstrated potential in the later plantings. Some of these have since been released for commercial production.

4. Section 1 - Comparison of 1996, 1997 and 1998 Trials

4.1. Materials and Methods

Variety Assessment

Four plantings were undertaken in 1996, 1997 and 1998 at approximately monthly intervals. Details for the 1996, 1997 and 1998 plantings are described respectively in Sections 2, 3 and 4 of this report. In this section (1) of the report, the mean values for various attributes measured on those varieties harvested for each of the plantings are presented. These attributes include days to harvest, yields within various grades, quality factors at harvest and storage characteristics.

Jumbo Assessment

Trials were undertaken in 1996, 1997 and 1998. A general discussion of the jumbo trials and the potential of this niche market is presented in this section (1). Expanded trial results to reinforce this discussion can be found in Section 5 of this report.

Other Alliums

The potential for the development of specialised pickler onion varieties, Japanese bunching onions and true shallots was included as a component of this project. The only field trial conducted was an observation trial of six varieties of true bulbing-shallots obtained from the Fairbanks seed company. This includes the varieties Atlas, Matador, Ambition, Tropix and Rox. All varieties grew well but did not develop bulbs. This is due to the fact that they require long days to initiate bulbing and Queensland is a short day environment.

A search for Japanese bunching onion germplasm proved unsuccessful. Consequently no trials were conducted.

The production of pickler onions is centred on varieties planted out of season to produce a small bulb. A search of seed companies internationally has revealed that there are no varieties bred specifically for the commercial production of pickling onions. Rio Colorado Seeds in the USA has developed a variety called Igloo but this is unlikely to be suited to Queensland growing conditions as it is a long day type. Consequently, no trials were conducted into the potential of pickling onions in Queensland.

4.2. Results

Variety Testing

Days to harvest

The time from planting to harvest for the varieties are presented in Figure 1 [(a) – 1996 plantings, (b) – 1997 plantings, (c) – 1998 plantings] and Figure 2 (combined years and time of planting).

In 1996, the June growing season was 2-3 weeks shorter then all other plantings. Figure 1(b) illustrates the three aspects of the growing season for transplants namely, planting to transplanting in the field, field planting to harvest and total. Indications are that the earlier the planting the sooner the transplants are available. March and April growing seasons in 1997 were longer than the May and June plantings. In 1998, the March planting was approximately three weeks longer than all other plantings. In 1996 the growing period for April and May was three weeks longer than the corresponding plantings in 1998. This was due to the high mildew pressure in the April and May plantings in 1998. Consequently, the 1998 April and May growing seasons were shortened by the premature maturity all cultivars in 1998.

Comparing all three years (Figure 2), the growing season did not vary greatly from year to year within each of the planting times. There was a shortening of the growing season from March through to June from 180 days to 160 days. The exception is when transplants were used particularly in March and April. This was primarily due to the time required for the transplants to adjust to the transplanting (transplant shock).

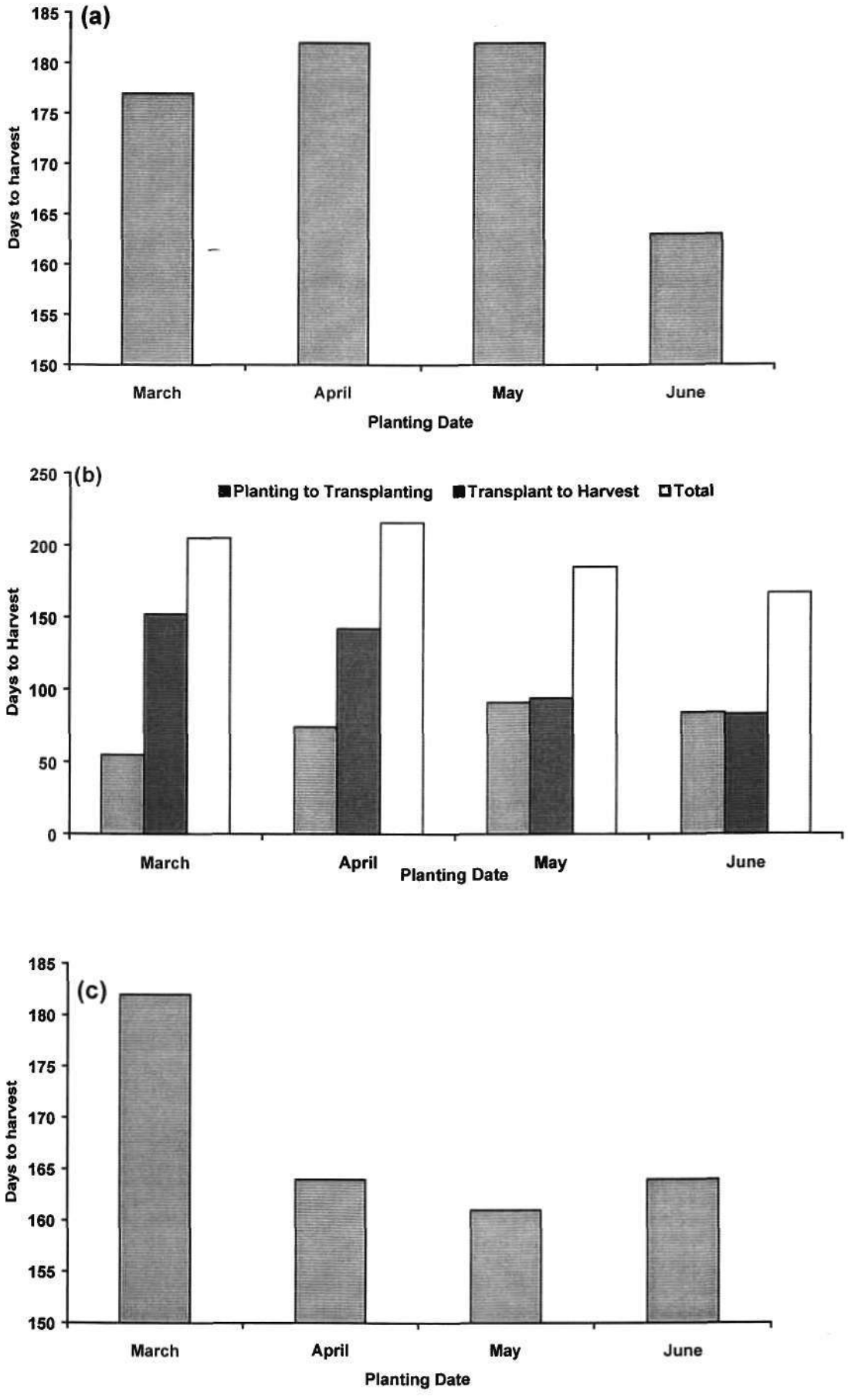

Figure 1. Days to harvest averaged for each of the plantings in 1996: (a), 1997: (b) and 1998: (c).

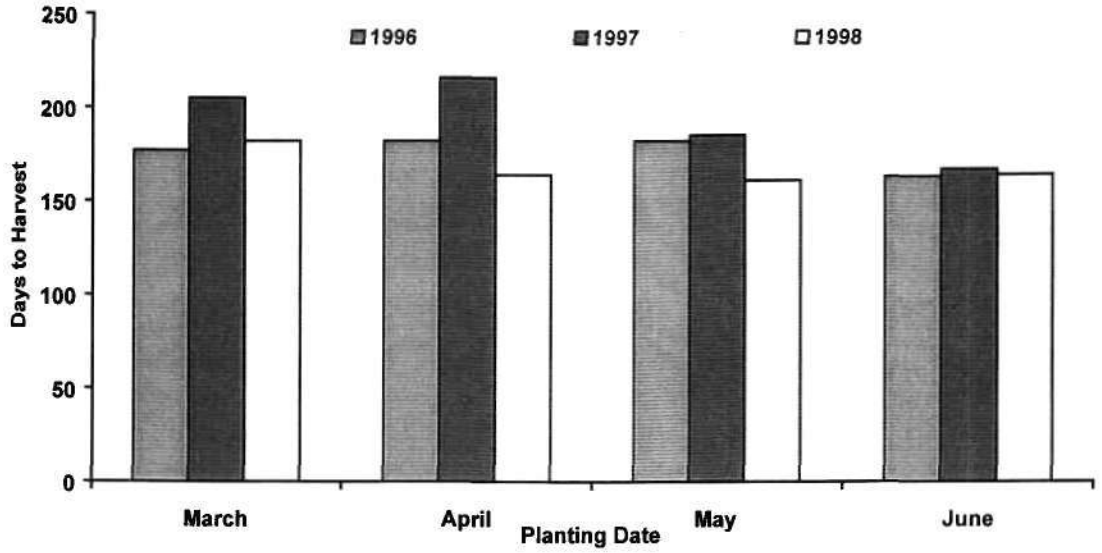

Figure 2. Days to harvest averaged for all plantings in 1996, 1997 and 1998.

Yield

Total marketable yield

Total marketable yield figures are illustrated in Figure 3 (a): 1996 plantings; Figure 3 (b): 1997 plantings and Figure 3(c): 1998 planting. In 1996, there was a steady yield increase until May which achieved the highest yield. The drop in yield in June resulted in the lowest yield of all four plantings. Hot humid conditions at harvest time contributed to this yield reduction. Yields in 1997 were variable across all four planting times. This is primarily due to the problems associated with obtaining consistently good transplants throughout the season. Highest yields were obtained from the March and May plantings. There was very little difference between yields in the 1998 trials.

Averaging the total marketable yield for the three years of the testing is illustrated in Figure 4. It can be seen that the optimum time for planting to maximise yield is May. There is little or no difference between the other three planting times. This trend is also highlighted by grower practices. The majority of growers in the Lockyer Valley and on the Darling Downs will plant the bulk of their crop during May. This yield pattern illustrates the effect lengthening days and lower temperatures have on a long-day plant type. Improved yields are to be expected under these conditions. The development and adoption of hybrid cultivars has also resulted in increased yields for later season plantings allowing greater supply of onions for domestic and export markets when onions from other states are in low supply.

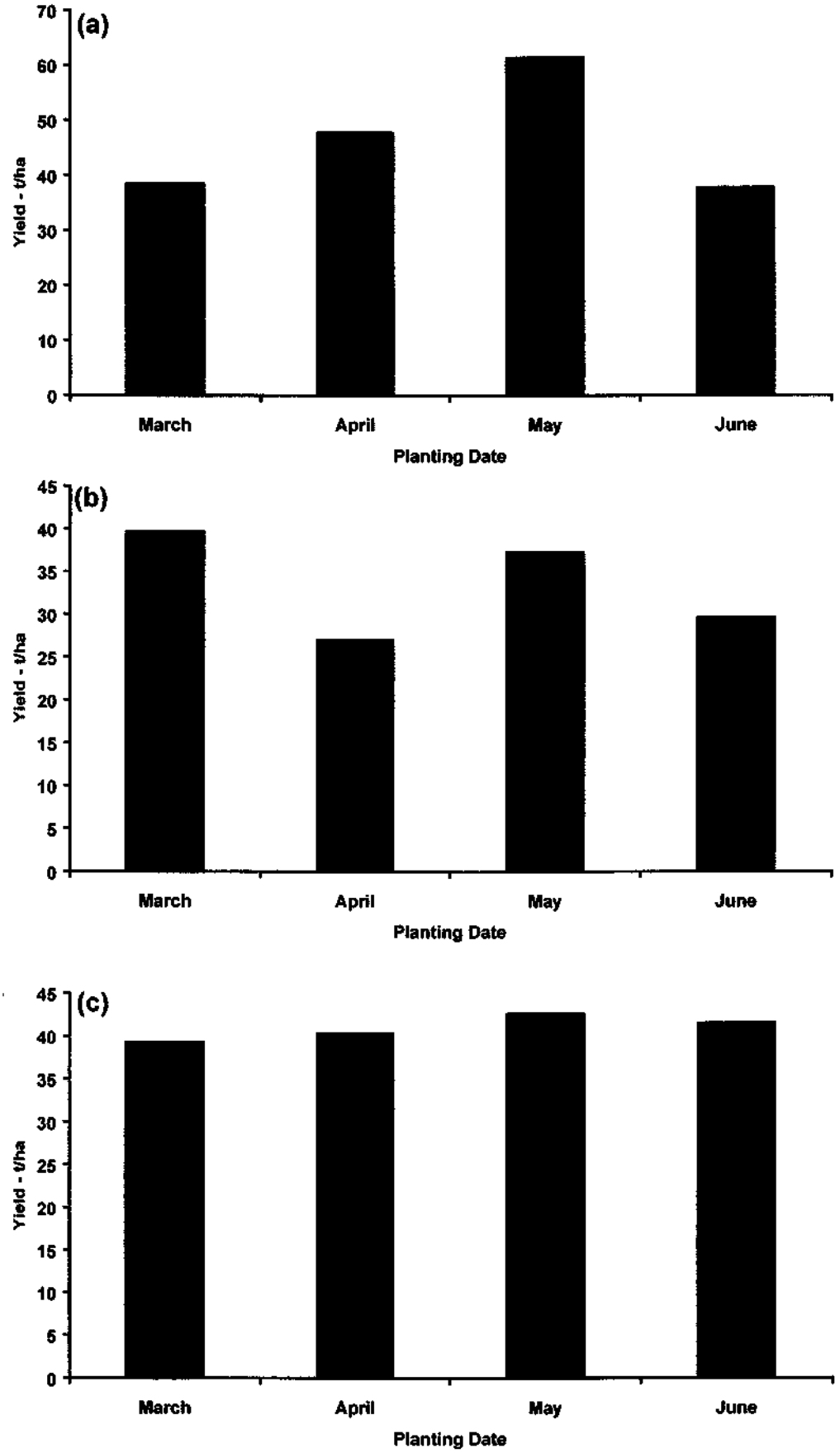

Figure 3. Total Marketable yield averaged for each planting in 1996:(a); 1997:(b) and 1998:(c)

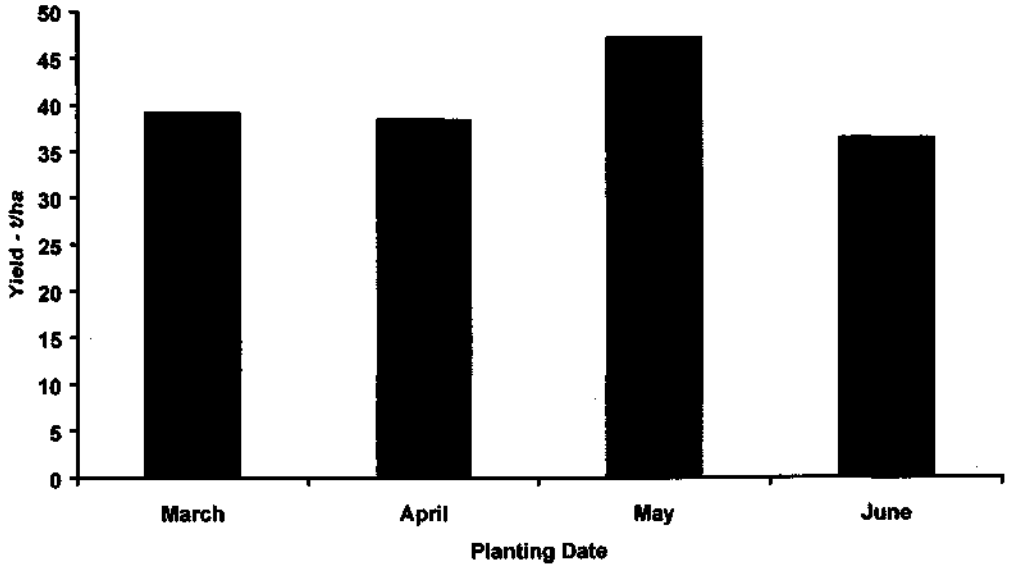

Figure 4. Total marketable yield averaged for each of the plantings over the three-year testing period.

Grade yields

The yields of picklers, No 1 and No 1 large for the 1996,1997 and 1998 plantings are presented in Figure 5. In general, very few picklers were produced throughout the three years of testing. 1997 trials yielded the highest tonnage of picklers although the percentage of total marketable yield was still quite small. Yield of No 1 Grade bulbs (40-70mm) was highest for all plantings in 1997 when compared to corresponding plantings in 1996 and 1998. This is attributed to the use of transplants. In 1997, transplanting caused the initiation of bulbing earlier than for corresponding trials in 1996 and 1998 resulted in smaller leaf areas. Consequently, the plants were unable to produce sufficient numbers of bulbs with a diameter greater than 70 mm. Yields of No 1 grade bulbs in 1996 and 1998 were similar at all planting times except in June when the yield was significantly higher in 1998 than in 1996. High levels of downy mildew in 1998 account for this yield difference. The use of transplants is once again responsible for the smaller yield of No 1 large grade bulbs in 1997 when compared to corresponding trials in 1996 and 1998. The highest yields of No 1 large grade bulbs occurred in 1996 trials at all times of planting. Maximum yield was obtained in the May planting in 1996. In 1996 and 1998 the yield of No 1 large grade bulbs accounted for the greater percentage of the total yield. This did not occur in 1997 for reasons outlined previously.

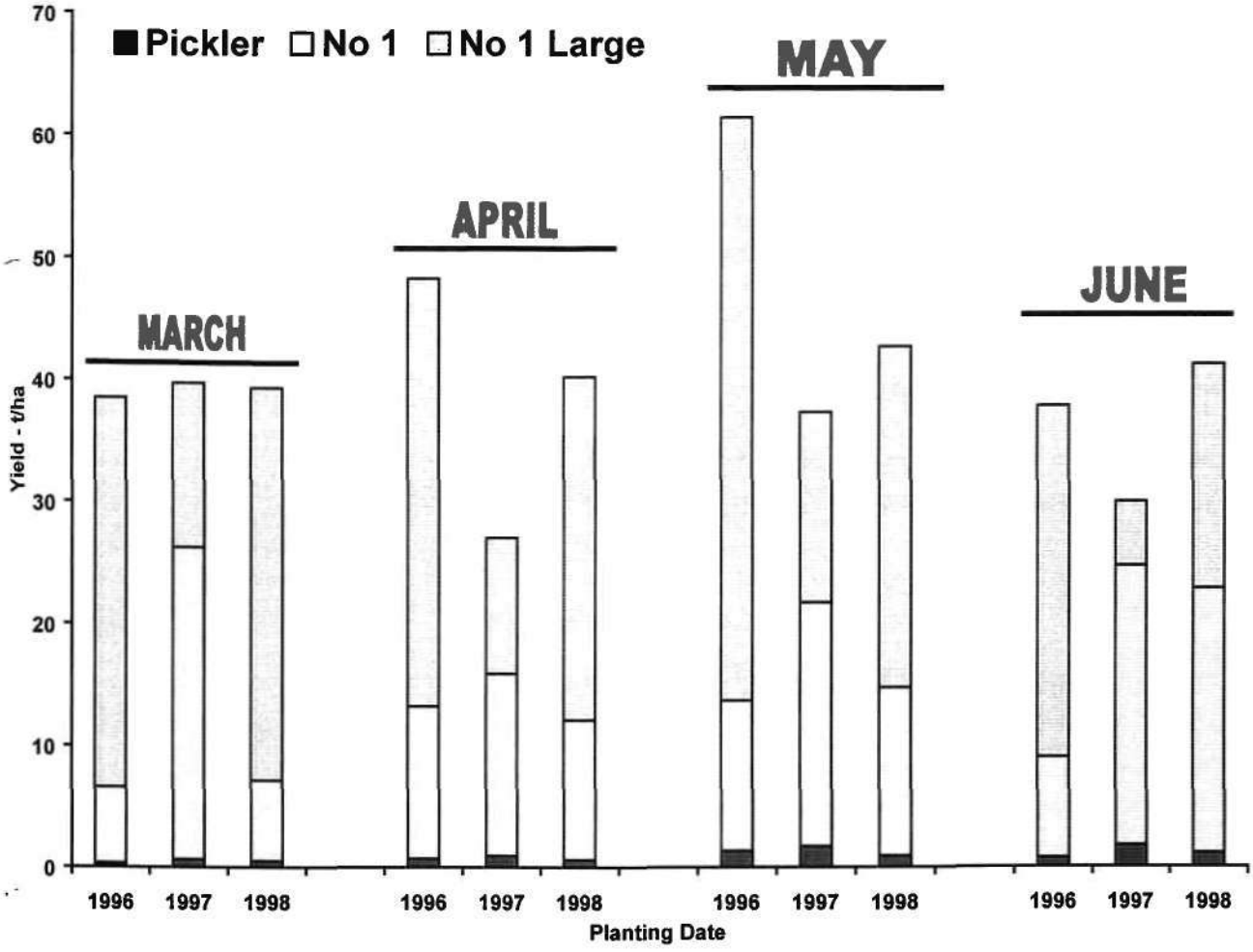

Figure 5. Averaged yields (t/ha) within the pickler, No. 1 and No. 1 large grades for plantings in 1996, 1997, and 1998.

Yield of doubles, off-types and purples

Details of non-marketable yields for the plantings in 1996, 1997 and 1998 are presented in Figure 6(a), Figure 6(b) and Figure 6(c) respectively.

Doubling is a major problem in early-planted onions, particularly March. This is evident for all years with an average yield of 8 t/ha and 14 t/ha in 1996 and 1998 respectively but a lower average of 1.7 t/ha in 1997. In part this was due to the lack of environmental conditions (a prolonged period of high temperatures) conducive to the formation of doubles. Doubling occurred at all other planting times throughout the three years of testing but the yields were considered negligible. The incidence of doubling tends to be higher in open pollinated cultivars. This explains the high levels experienced in the March plantings. The early plantings consist of predominantly open-pollinated cultivars, as there are little or no hybrid lines suited to such an early time slot. In general, hybrid varieties tend to dominate later plantings.

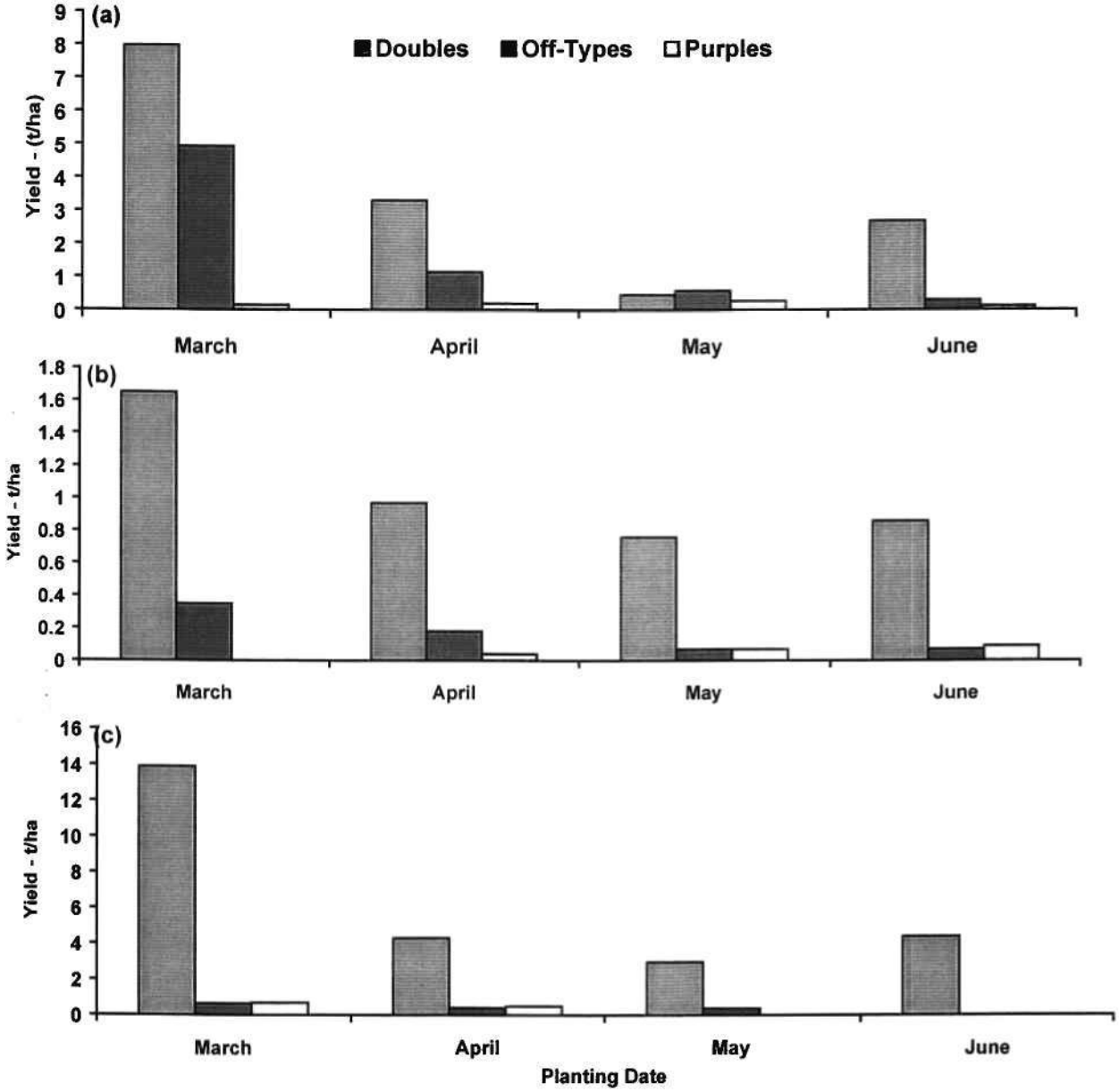

Figure 6. Yield (t/ha) of unmarketable grades from plantings in 1996:(a); 1997:(b) and 1998:(c).

The incidence of off-types was generally negligible except in March 1996. This was particularly attributed to contamination in Brooking's Early Lockyer White which was contaminated with a substantial percentage of brown bulbs and Litzow's Golden Brown which was contaminated with white bulbs.

The level of purpling was negligible. This was pleasing as occasionally Early Lockyer Brown strains tend to have a high level of purpling. This trait is generally difficult to remove from some brown cultivars.

Incidence of bullnecks and seed heads

Data for these characteristics are illustrated in Figure 7(a), 7(b) and Figure 7(c) for 1996, 1997 and 1998 plantings respectively. The incidence of bullnecks was below 5% in all three years of testing regardless of planting date. The highest level was in March 1996 when a level of 4.3% was reached. This was due to the high numbers of bulbs in the local Golden Brown strains. The percentage of bullnecks is mainly increased by uneven plant stands or poorly adapted varieties to a particular planting date.

The production of seed heads was most pronounced in the March and April plantings in all three years being more evident in 1996. Two factors are necessary to induce the production of seed heads or bolting in onions. These are the physiological age of the plant and temperature. The optimum physiological age for the onion to be receptive to low temperature that results in floral initiation is the stage once the plant has 4-6 true leaves visible. The optimum temperature at this stage for floral initiation is 5-12 degrees Celsius. Varieties also vary in their reaction to these conditions, but it is obvious that the greatest chance of the floral initiation requirements of a variety being met is likely to occur with March and April plantings when the likelihood of reaching these temperatures is greatest. In 1996 there was a week of low temperatures, in mid May, which exposed the plants to environmental conditions that resulted in a higher than usual incidence of seed head production.

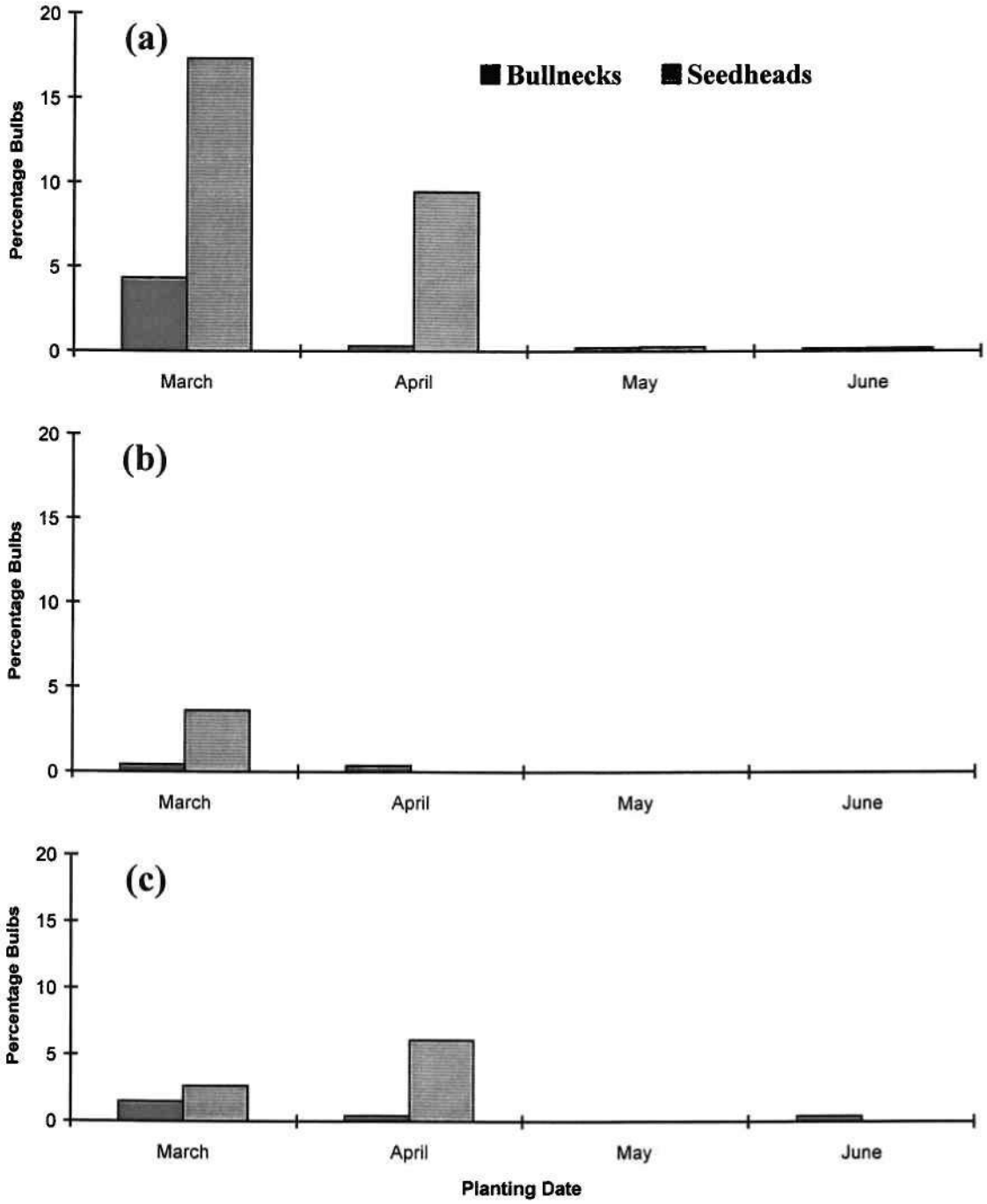

Figure 7. The incidence of bullnecks and seed heads in the various plantings in 1996:(a); 1997:(b) and 1998:(c).

Post Harvest Measurements

Post harvest measurements were carried out in 1996 and 1997. Time constraints and extremely hot and humid storage conditions resulted in no post harvest measurements being carried out in 1998.

Incidence of greening

Details illustrating the effect of planting time on greening of bulbs are shown in Figure 8(a) and Figure 8(b) for 1996 and 1997 respectively. In general terms the level of greening in 1996 was 50 – 80% higher than the 1997 levels. This could be a result of using transplants in 1997 where the bulbs were planted closer to the surface and as a consequence exposed to more direct sunlight. The white varieties displayed higher levels of greening than the brown or red varieties. There tended to be more white varieties tested in 1996 than in 1997 resulting in higher average levels of greening. On the whole, the levels of greening were quite low with only two lines being adversely effected.

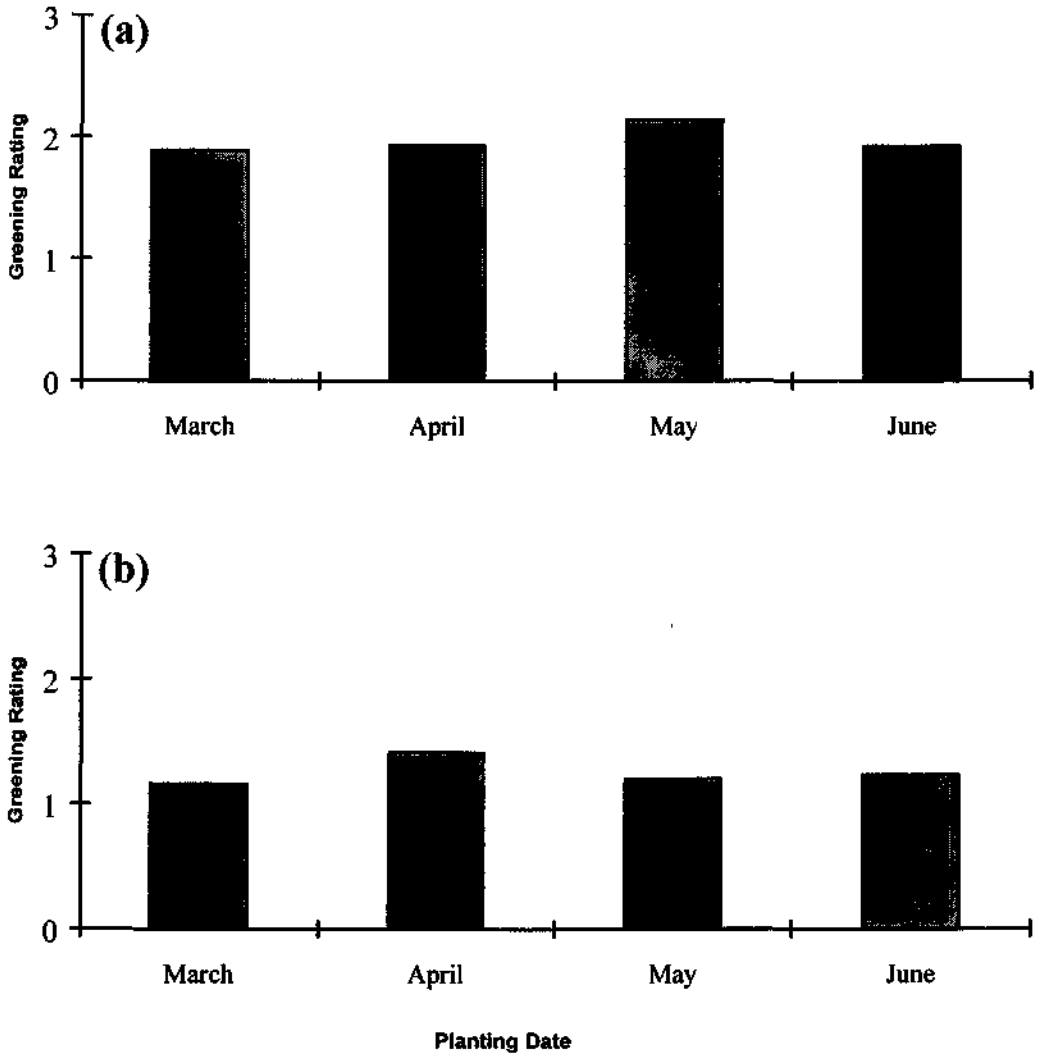

Figure 8. The occurrence of greening in the various plantings in 1996:(a) and 1997:(b).

Number of skins

The number of complete shells for the various plantings for the both seasons is shown in Figure 9(a) for 1996 and Figure 9(b) for 1997. The number of complete skins averaged between two and three for all plantings in both years. The average skin number was lowest in June and April in 1996 and 1997 respectively. Individual varieties developed between four and five skins and these are detailed in the results in Sections 2 and 3 of this report. Generally, both domestic and export markets are seeking the retention of 2-3 good skins on onions, a problem that is associated with the short-day, salad onions, particularly Golden Brown.

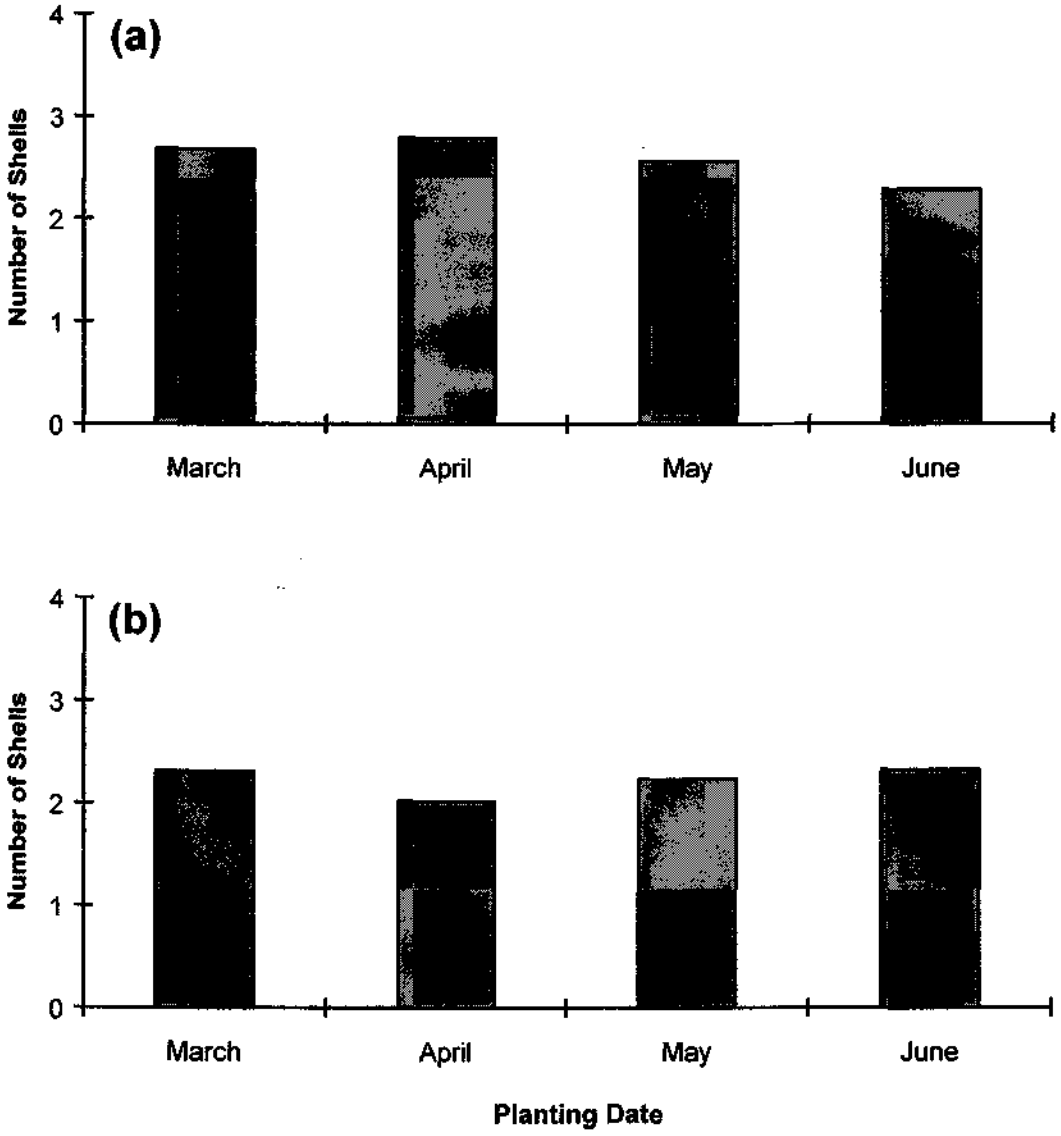

Figure 9. Average number of complete shells retained for bulbs in plantings in 1996:(a) and 1997:(b).

Soundness and black mould incidence

The percentage of sound bulbs and the incidence of bulbs showing some symptoms of black mould for the various plantings are shown in Figure 10(a) and Figure 10(b) for 1996 and 1997 respectively. These assessments were made on bulbs that had been stored for 10 – 14 weeks from harvest. The keeping quality of the bulbs in 1996 was superior to those bulbs in 1997. In 1996 and 1997 the keeping quality of bulbs from the March planting was very poor. This is a major problem in early season onions. These onions are generally soft and will not keep for more than 4-6 weeks. The quality of bulbs produced from the 1997 April planting was poor due to heat stress at harvest. Consequently, these bulbs did not store well. Late season varieties will store better than early season cultivars due to the likelihood of Cream Gold parentage in the genetics of the variety.

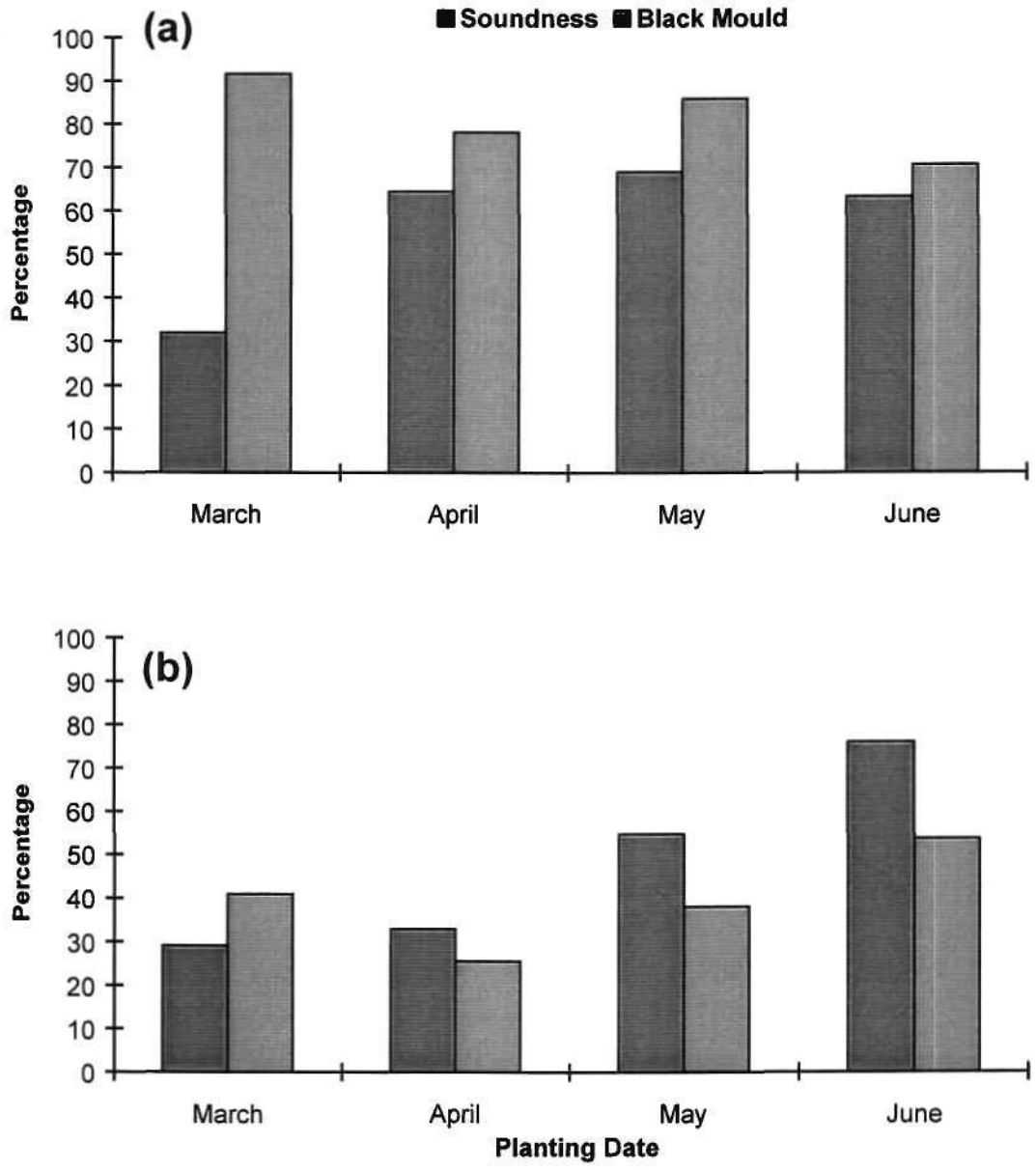

Figure 10. The percentage of sound onions and the incidence of black mould after storage from plantings in 1996:(a) and 1997:(b).

The development of black mould is a major problem in storage of salad onions. All plantings in 1996 had high levels of black mould. Levels as high as 91% occurred in the March planting. The incidence of black mould exceeded 50% in all cases. In 1997, black mould averaged 25% or more in bulbs stored from all plantings. While many bulbs had slight infection with black mould, they were still classed as sound ie no sign of obvious breakdown. It is possible that thrips in storage predispose onion bulbs to the development of black mould by rupturing the surface and providing a ready entry point for the disease.

Soluble Solids (Sugar) Levels.

The average soluble solid concentrations for the plantings in 1996, 1997 and 1998 are shown in Figure 11. Soluble solid levels give a measure of sugar content in onions. This factor is important in determining the suitability of an onion cultivar for the sweet onion market either domestically or for export. The higher the level the sweeter the onion will tend to be. In general, if the level is too high then a corresponding high pungency level will mask this sweetness. The level of sweetness varies from season to season and is influenced by climatic conditions. An onion with a brix (%) of 8 or greater is considered to be suitable for the sweet onion market. Average brix levels in 1996 and 1998 indicate that the majority of cultivars would have been suitable for the sweet onion market. Brix levels in 1997 are markedly lower than in 1996 and 1998. Anecdotal evidence suggests that this may be due to the variability of climatic conditions from year to year. This may be due to excessive rainfall close to harvest resulting in lower sugar concentrations in the bulb at harvest. The brix levels were all less than 8.0 % for the 1997 season.

The three-year average is also presented in Figure 11. This indicates a gradual decrease in sweetness of the onion from March through to June. Sweet onions tend to be short day types that, in Queensland, are planted early in the season. In general, the more pungent varieties (intermediate to long day cultivars) are planted later in the season. As stated previously these more pungent types will have high levels of soluble solids with corresponding high pungency levels. The trend depicted in Figure 11 does not support this. This result tends to agree with Queensland experiences where there are shorter days and differing climatic conditions to those experienced in southern Australia.

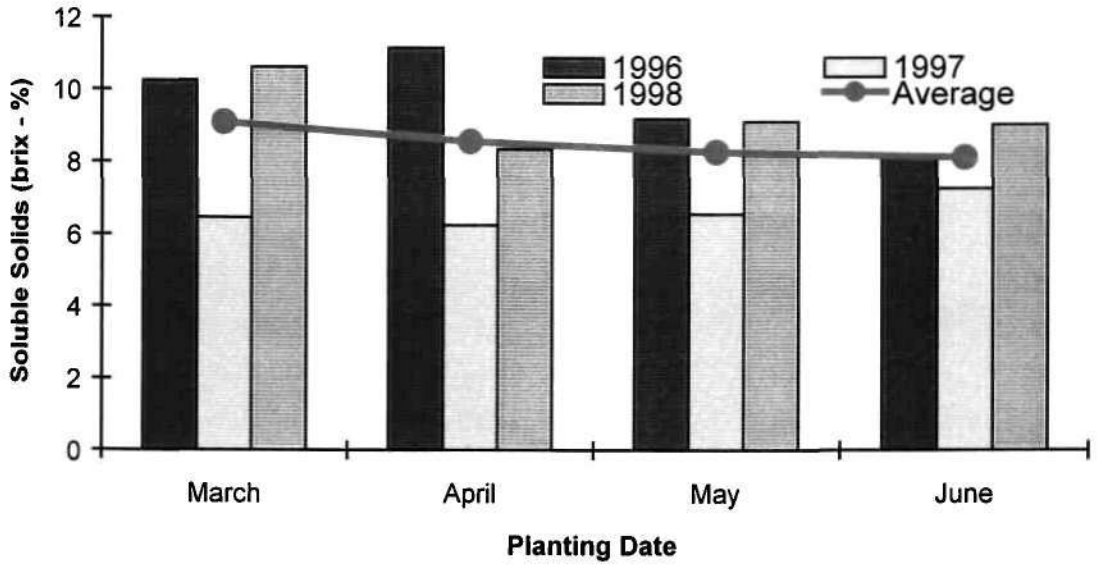

Figure 11. Soluble solid levels (brix %) averaged for each of the plantings in 1996, 1997 and 1998.

Jumbo Testing

Yield

The average yield (t/ha) for bulbs 0-100mm, 100-125mm and 125-150mm in diameter for the trial in 1996 is presented Figure 12. Although the yields were quite good in the jumbo sized range there was also a large number of doubles produced. Consequently, these varieties are not suited to the March planting time.

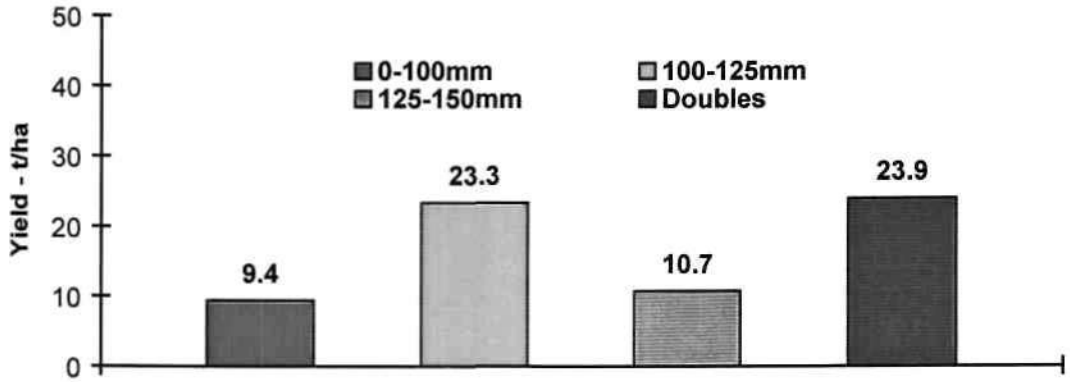

Figure 12. Yield (t/ha) of bulbs 0-100mm, 100-125mm and 125-150mm in diameter for jumbo onion trials in 1996.

The average yield (t/ha) for bulbs 0-100mm in diameter and greater than 100mm (jumbo) in diameter for trials in 1997 are presented Figure 13. The results indicate that insufficient yields of jumbo onions were produced to economically supply a jumbo onion market.

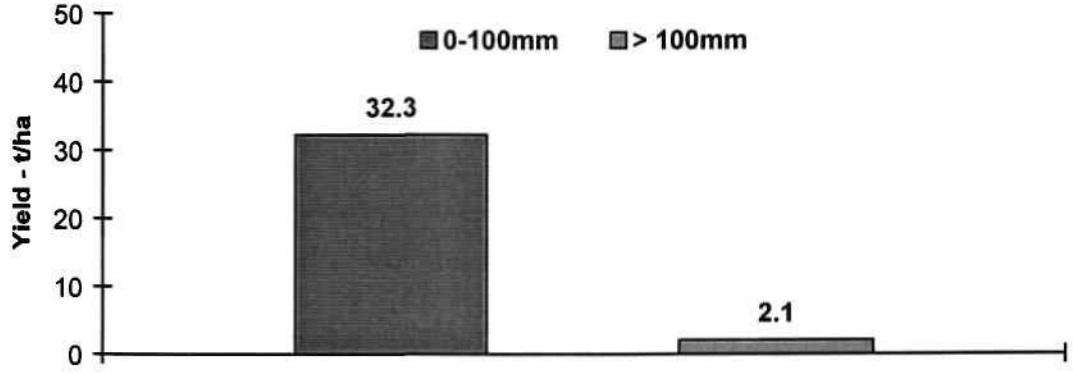

Figure 13. Yield (t/ha) of bulbs 0-100mm diameter and > 100mm diameter for jumbo onion trials in 1997.

The yield (t/ha) for bulbs 0-75mm diameter 75-100mm and greater than 100mm (jumbo) in diameter for the trial in 1998 are presented Figure 14. The only significant difference in the 1998 nitrogen trial occurred between the individual varieties. The Yates variety Colossus is classified as a jumbo variety by the seed company. This variety produced significantly greater yields in both the 75-100mm and > 100mm grades. The yields of bulbs > 100mm is insufficient to ensure economical viability as a jumbo onion for either of the varieties tested.

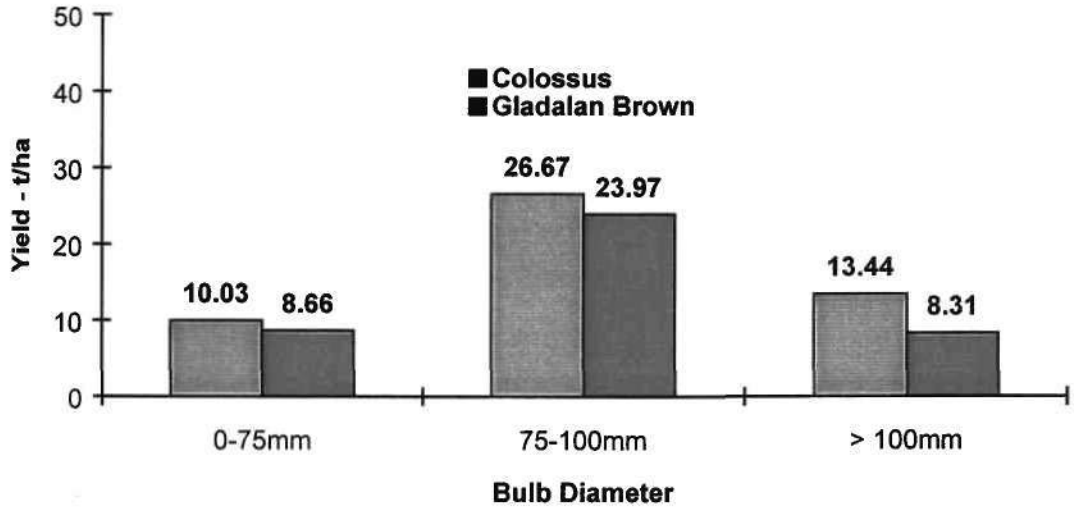

Figure 14. Yield of all grades for the Varieties Yates' Colossus and Gatton Research Station Gladalan Brown tested in 1998.

4.3. Discussion

Variety Testing

Locally produced strains of Early Lockyer White, Early Lockyer Brown and Golden Brown continued to be the best-adapted varieties for early season production. The Neuendorf strain of Early Lockyer White was the best early season white onion. This strain originated from the line developed by the late Roy Brooking a resident of the Lockyer Valley. Several Golden Brown strains were evaluated and there was little difference in the performance between these strains. The Else strain performed well over the three-year trial period and over the range of planting dates. The Golden Brown variety offers good potential for export provided care is taken with curing and post harvest storage. Golden Brown is thought to have its origins in the cultivar Senshu Yellow. Senshu Yellow is an important variety in China and Japan. The Yates cultivar Cavalier (E515) was released for commercial production in 1998. This variety performed well in both March and April plantings in each of the testing years. The seed company has recommended this variety for a late April to mid May planting only due to the likelihood of bolting when planted early.

In the mid season varieties, Golden Brown continued to perform well as did Wallon Brown, Yates hybrids Cavalier (E515), Predator (E544), Colossus (E511), Terminator (F550), and Nautilus (E517), Magnus Kahl's 1367 and South Pacific Seeds White Diamond (formally Lefroy Valley's

Diamond White - RS 94518). The Yates cultivars Cavalier, Predator, Nautilus and Terminator were released for commercial use with the aid of data collected during the life of this project. The red skinned varieties Henderson's Red Rojo and South Pacific Seeds' Rio Demon bulbed satisfactorily in a May planting, but bulb quality was variable.

The standard varieties Centurion and Gladiator performed well in the late season plantings as well as a number of new hybrids including South Pacific Seeds Columbus (846), Yates Colossus (E511), Z549 and Predator and Henderson's Samba. All varieties tested are hybrids as no local strains are adapted to a June timeslot. Diamond White was the only white variety included in the late season trials. It performed reasonably well and is now commercially available to growers.

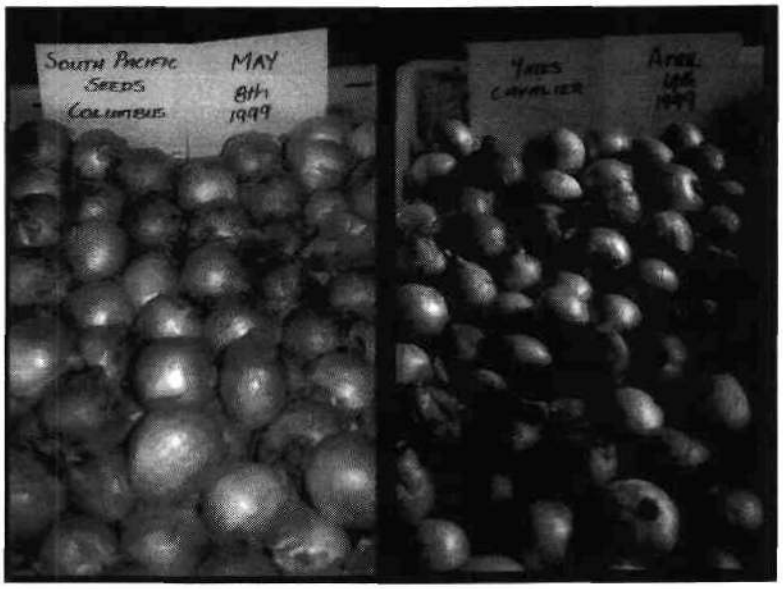

Plate 1. The varieties South Pacific Seeds Colombus (left) and Yates' Cavalier (right) are examples of varieties tested during the three years of the testing program.

As a result of these trials Cavalier, Predator, Nautilus and Columbus have become established varieties and commercial plantings of these promising new hybrids are taking place. This has included trial plantings in other potential onion growing areas including Bundaberg and Mareeba. Golden Brown continues to be exported to Asia as a mild sweet onion. Gladiator and Centurion are also exported to Asia to supply markets that require a more pungent onion.

Jumbo Assessment

The jumbo onion market is a niche market that is small in size. A number of seed companies have varieties available that will produce jumbo-sized onions when planted at the correct spacing. The market requires onion bulbs greater than 100mm in diameter and that are single centred. Trials in 1996, 1997 and 1998 concluded that the selection of the correct variety is essential to ensure adequate yields of jumbo-sized onions.

The 1996 trial was a preliminary investigation to determine the optimum field conditions for the production of jumbo onions. Transplanting will require a suitably designed transplanting machine for onions, as labour costs for manual transplanting other than experimental plots (Plate 2) would be far too costly. Direct seeding using an air seeder is the best alternative as accurate spacing can be achieved. Direct seeding at a plant spacing of 150mm was the most cost-effective method for

planting. This result was used in the following years' trials to maximise the yield of jumbo sized onions.

During 1997and 1998 testing no variety produced sufficient yields of jumbo-sized onions (> 100mm) to satisfy investing in the jumbo onion market. The Yates's variety Colossus produced the best yields in the required size range (12.7 t/ha and 13.4 t/ha respectively).

Although there seemed to be a trend in that increasing rates of nitrogen increased the yield of bulbs greater than 100mm this increase was not significant(See Section 5, Appendix 1). Different times of nitrogen application had no effect on the yield of jumbo onions.

Plate 2. Transplanting jumbo onions in 1996.

4.4. Technology Transfer

Field Days

A number of well-attended field days (See Appendix 1) were held at strategic times during the growing season in each of the three years of the project. The major field day in 1998 incorporated an update for growers and agri-business on all aspects of onion research being carried out at Gatton Research Station. In addition to the varietal evaluation program, latest information on downy mildew forecasting, pesticide application technology, registration of the herbicide Goal® and onion white rot control was presented. During the project the project leader performed numerous one-on-one up-dates and tech-transfer activities with seed grower representatives, producers and marketers. A field day was also organised for overseas visitors during the 1997 season. This field day coincided with the 2nd International Symposium on Edible Alliaceae in Adelaide.

Plate 3. Interested growers inspecting a selection of onion varieties on display at one of the five field days held during the progress of this project.

Publications

A number of articles (See Appendix 1) were published throughout the life of the project. Articles were published in "Onions Australia" from 1997 to 1999. A paper was presented at the Second International Symposium on Edible Alliaceae, Adelaide, Australia in 1997. Progress reports were presented to QFVG and participants in the trials to enable them to make decisions for the following year's plantings.

Other Media

A short video was made for the Channel Ten children's show Totally Wild in 1998. This involved demonstrations of the different varieties and their uses in cooking. This was aired in March 2000.

An up to date list of current varieties was included in the QDPI publication "Onion Information Kit". This reference is available to all areas of the onion industry. Results from the trials contribute to the recommendations in this publication.

4.5. Acknowledgments

The Heavy Produce Committee of the Queensland Fruit and Vegetable Growers and the Horticultural Research and Development Corporation are gratefully acknowledged for their financial support of this project as are the following seed companies who contributed funds on a per entry basis. The participating seed companies were Yates Vegetable Seeds, Hendersons' Seeds, Lefroy Valley East, Magnus Kahl, New World, Sandoz, Hazera, Rijk Zwaan and South Pacific Seeds.

The supply of seed of local early varieties by Messrs Tom Else, Reg Neuendorf, Phillip Dunlop, Des Reisenleiter, Shane and Elwyn Litzow and Edgar and Shane Schulz is also appreciated.

4.6. Appendix 1

Field Days

1996:

19th June 1996
11th October 1996

1997:

31st October 1997
7th November 1997 Overseas field walk

1998:

26th November 1998

Publications

Jackson, K.J. and Duff, A.A. and O'Donnell, W (In Press). Development of a suite of onion varieties for the subtropical region of the Lockyer Valley in S. E. Queensland, Australia. Proceedings "Second International Symposium on Edible Alliaceae, Adelaide, Australia."

Duff, A.A. and O'Donnell, W (1999) The Life of an Onion Researcher. *Onions Australia* 16

Duff, A. A., Jackson, K. J. and O'Donnell, W. (1998) Sweet Onions for Queensland. *Onions Australia* 11 : 15-21.

Jackson, K.J., Duff, A.A. and O'Donnell, W. (1997). Jumbo onions. *Onions Australia* 14 : 19-21.

Other Media

Totally Wild Video Shoot: 26th August 1998

Duff, A. A. and Elder, R. (1999). Onion thrips in Onions. DPI Note. Agdex 256/622

QDPI Onion Agrlink: 1999 Update (technical input)

5.0 Section 2 - 1996 Variety Trial Series

5.1. Introduction

All four planned plantings in the 1996 trial series were successfully completed. This report presents results of each of these plantings. Results will be presented in tables that will contain data on three major areas of assessment. These areas are (i) yield, (ii) percentage make-up of the various bulb categories per plot as well as number of centres per bulb at harvest and (iii) bulb description, soluble solids per bulb (brix %) and storage data. This progress report is designed to allow seed companies to decide which plantings and which varieties they would like to consider for the planned trial series in 1997.

5.2. 1996 participants

Seven commercial seed companies, and four local seed growers contributed varieties for assessment. In addition, varieties developed at Gatton Research Station were also entered in various plantings. The seven seed companies were New World, Sandoz Seeds, Lefroy Valley East, Magnus Kahl, South Pacific, Yates and Hendersons. Local seed growers who participated were Tom Else, Reg Neuendorf, Elwyn Litzow and Edgar Schulz.

5.3. Climatic data

The climatic data for 1996 are presented in Table 1 where certain components are compared with corresponding long-term averages.

Table 1 Average maximum and minimum monthly temperatures and monthly rainfall for 1996 as well as monthly daylength range for Gatton Research Station.

Month	Av max temp (^{0}C)		Av min temp (^{0}C)		Rainfall (mm)		Daylength (hrs)
	1996	Long-term	1996	Long-term	1996	Long-term	
January	30.5	29.8	20.5	18.2	166.1	113.2	14.1 - 13.7
February	30.7	30.5	18.4	18.8	53.2	100.7	13.7 - 13.1
March	29.3	28.8	16.4	16.8	29.4	78.7	13.1 - 12.2
April	28.2	26.3	13.0	14.7	46.0	52.5	12.2 - 11.4.
May	23.1	22.6	12.6	9.8	439.6	47.8	11.4 - 10.8
June	21.7	22.6	9.8	7.4	10.6	43.7	10.8 - 10.6
July	19.9	20.4	6.4	6.1	35.9	40.9	10.6 - 10.9
August	21.9	21.4	7.3	6.5	45.4	27.9	10.9 - 11.6
September	25.7	24.7	8.5	9.1	24.0	35.5	11.6 - 12.4
October	27.1	27.8	13.6	12.7	43.8	65.3	12.4- -13.0
November	30.7	29.0	14.3	15.7	62.0	75.3	13.0 - 13.9
December	31.0	29.6	18.0	16.5	81.4	99.2	13.9- -14.1

5.4. Testing procedures

In each planting, 3 replicates or plots of each entry were established. Each plot consisted of a pair of single rows (used to determine yield) and a single guard row on either side. Plots were established on beds with 1.5m centres. Seed was planted at the rate of 1.5g per row to ensure that slightly more than the desired plant stand was achieved. Plant stands were hand thinned to an intra row spacing of 100mm to give a plant population of 27 plants/m^2 (270 000 plants per hectare). Plots were 10m long and yield was measured from 8m of each of the single rows leaving a buffer of 1m at each end of the plot. Varieties were harvested when 80-100% of the tops were down and allowed to dry in trays before mechanical grading. Several varieties were not harvested due to excessive numbers of seed stems (> 50%). These varieties are denoted by NH in the yield data tables.

At harvest, the number of seed stems and bullnecks were counted. When grading, the number of doubles, purples and off-types (off-colours) were recorded as well as the numbers within the pickling, No. 1 and No. 1 large grades. These grades refer to bulb diameters with the pickling grade being 20-40mm, the No.1 grade 40-75mm and No. 1 grade being greater than 75mm.

Immediately after harvest, 30 bulbs were randomly selected from the remaining unharvested portion of the central rows of each plot. Five of these were used to determine total soluble solids, five were used to determine the number of centres per bulb and the remaining 20 were stored in racks to determine the effect of storage on bulb quality. Two weeks after harvest the bulbs were tested for firmness. After a further 8-12 weeks, the bulbs were assessed for the number of skins (broken, split and complete), skin colour, bulb shape, soundness (incidence of breakdown), firmness, degree of greening (1 nil - 5 intense) and incidence of sooty or black mould (*Aspergillus niger*).

5.5. Results

Yields expressed in t/ha of saleable onions (picklers, No. 1 grade and No. 1 grade large) as well as yields of reject bulbs (doubles, off-types and coloured) are presented in Tables 2(a) (plantings 1 and 2), 2 (b) (planting 3) and 2(c) (planting 4). Similarly, the percentages of bulbs per plot falling into the various categories are presented in Tables 3(a), 3(b) and 3(c) and additionally number of centres per bulb and seed stem production are presented in Tables 3(a) (plantings 1 and 2), 3(b) (planting 3) and 3(c) (planting 4). Shape, colour, soluble solids (brix%) and storage details from the various plantings are presented in Tables 4(a) (plantings 1 and 2), 4(b) (planting 3) and 4(c) (planting 4).

5.6. General comments

Seasonal conditions

Above average rainfall (425mm in six days) in early May resulted in plant loss in the April planting. The water-logged soil produced conditions that favoured the development of damping off (*Pythium spp.*) resulting in seedling loss. The rain also delayed the May planting for a fortnight. A week of extremely high temperatures ie six consecutive days over 38° C from late November to early December caused severe breakdown of bulbs in the ground and later in storage for varieties from the fourth planting. Several varieties from the fourth planting had started to breakdown prior to being graded. These results are presented in Tables 2(c) (yield of rotten bulbs) and 3(c) (percentage of rotten bulbs). The occurrence of doubles was once again evident in the early to mid-season plantings. Four varieties from the fourth planting also had a high percentage of doubles. Downy mildew once again

infected all plantings but yield losses were minimal. The early to mid-season plantings were the most affected by this disease.

Early season varieties (Planting 1 - March)

Whites

The Neuendorf strain of Early Lockyer White produced the highest yield within this variety. The Brooking strain of Early Lockyer White from which all local Early Lockyer White strains originated had a very high incidence of brown bulbs. This seed was produced on the Research Station and it is evident that cross pollination occurred. The Schulz strain still has the undesirable trait of having a flat shoulder. The other white tested in this planting was an early white from Tom Else. This is not an Early Lockyer White and looks promising as it outyielded the Neuendorf strain.

Browns

Golden Brown is the most common variety for this planting. A number of local strains were tested. The highest yielding of these strains was the Schulz strain but again the flat shoulder is an undesirable character. The Else strain had the best appearance and shape. Litzow's strain suffered greatly from what seemed to be seed contamination either from cross-pollination or seed mixing at the source. Only one line supplied by Yates was harvested and shows some promise at this planting if the number of seed stems can be reduced.. The two lines from Magnus Kahl Seeds produced low yields with high percentages of doubles and seed stems.

Early Lockyer Brown was also featured at this planting. It is a variety maintained at Gatton Research Station and produced the highest yield of all varieties tested. The incidence of purple off-types although quite low is its main detraction.

Reds

The only red variety entered in this planting was SPS 837 which is possibly the earliest red variety available. Its major drawbacks are large percentages of bullnecks and seed stems.

Mid-Season Varieties (Plantings 2 - April; Planting 3 - mid May)

Whites

The whites in the second planting included both fresh market and processing types. Of the three fresh market types (Early Lockyer White, Else White and Wallon White (Gladalan White)), the Wallon White was the best suited to this time slot. The other fresh market varieties produced good yields but in excess of 10% seed stems. Both processing types (MKS 326 and 328) were low yielding and produced much smaller bulbs than the other varieties. The processing varieties stored better than the fresh market types.

All three whites entered in the second of the mid-season plantings were adapted to this time of planting. The Lefroy Valley East variety Diamond White produced the best yield. All three varieties broke down badly in storage. The Neuendorf Late White strain produced a very small plant top resulting in a large number of small bulbs.

There was a marked increase in yield of No. 1 Large onions when Diamond White was planted as jumbo when compared to the standard spacing of 100mm.

Browns

Various browns were entered in both plantings. Golden Brown tends to dominate the early part of this season with Gladalan Brown and Wallon Brown being the major varieties in the latter part of the season. In the first of the mid-season plantings, the best of the Golden Browns was the Neuendorf strain with the GRS and Else strains also performing well. Both the Gladalan Brown and the Wallon Brown outyielded the Golden Browns in this planting. This can be attributed to an increased number of seed stems produced in the Golden Browns than in previous years. Both Yates selections E515 and E546 performed well in this planting. However, seed stem production (19.3%) in E546 indicates that this variety may be suited to a later planting time. The New World selection NW157 also performed well at this planting but their Early Lockyer Brown had reduced yields due to a high percentage of unmarketable bulbs (20%) this included seed stems, doubles, off-types and purples. Both lines from Magnus Kahl Seeds had satisfactory yields but suffered due to high percentages of seed stems and doubles. The sole Lefroy Valley East variety tended to produce a high globe shape rather than the preferred globe shape. It also produced a large number of seed stems..

The majority of varieties tested in the third planting were browns. There were several outstanding lines entered in this planting with yields exceeding 70.0 t/ha (28 t/acre). This can be attributed to the fact that there were a large number of bulbs greater than 80mm in diameter. These lines included the Yates' hybrids E511, E544 and Z549, South Pacific Seeds' 778 and Pancho and Lefroy Valley East's RS 94278.

Spacing South Pacific Seeds' 897 as a jumbo did not result in a corresponding yield increase. This variety was marginal with regards to size (100-120mm) when considered as a jumbo.

Reds

Two reds were entered in the mid season trials, South Pacific Seeds' 837 and Henderson's 678. South Pacific Seeds' 837 was entered in both plantings and performed best in the second of the mid-season plantings. Henderson's 678 was only entered in the second of the mid-season plantings and although had good yields its flat shoulder may be cause for concern. Both varieties offer potential on the red salad onion market.

Late Season Varieties (Planting 4; mid June)

Whites

Only one white was entered in this planting, Lefroy Valley East's Diamond White. It suffered quite badly from the hot conditions at the end of the season. Bulbs broke down both in the field and during storage prior to grading and weighing. As a result yields are quite low.

Browns

Heat stress caused major problems for most browns in this planting. The varieties either broke down in the field (New World's NW154 and Lefroy Valley East's 135) or in storage prior to weighing and grading (Yates' E511, Magnus Kahl Seed's 817, New World's NW154, Lefroy Valley Seed's 135 and Henderson's Samba). Despite this heat stress some

varieties still managed to yield well and look promising. These lines included Yates' E544 and Z549, South Pacific Seeds' 846, and Lefroy Valley East's 258. Magnus Kahl Seed's 686, 688 and 974 had a high percentage of doubles, particularly 688.

Three lines were spaced as jumbos in the fourth planting. These varieties were Lefroy Valley East's Diamond White, Henderson's Samba and South Pacific Seeds' 897. Diamond White was the only variety of the three that satisified the size requirements (100-120mm). Yields for all varieties were low with a large percentage of rotten bulbs occurring in both Diamond White and Samba.

LEGEND

GRS-ELB	Gatton Research Station -	Early Lockyer Brown (Barton Brown)
GRS-GoB	Gatton Research Station -	Golden Brown (Schroedon Brown)
GRS-GLB	Gatton Research Station -	Gladalan Brown (Wallon Brown)
ELS-GoB	Else -	Golden Brown
ELS-WH	Else -	White
NEU-ELW	Neuendorf -	Early Lockyer White
NEU-GoB	Neuendorf -	Golden Brown
NEU-WAB	Neuendorf -	Wallon Brown
NEU-WAW	Neuendorf.-	Wallon White
NEU-LW	Neuendorf.-	Late White
LIT-GoB	Litzow -	Golden Brown
SCH-ELW	Schulz -	Early Lockyer White
SCH-GoB	Schulz -	Golden Brown
BRK-ELW	Brooking -	Early Lockyer White
SPS-778	South Pacific Seeds -	Experimental Line 778
SPS-837	South Pacific Seeds -	Experimental Line 837
SPS-846	South Pacific Seeds -	Experimental Line 846
SPS-897	South Pacific Seeds -	Experimental Line 897(Jumbo)
SPS-PAN	South Pacific Seeds -	Pancho
HEN-SAM	Hendersons Seeds -	Samba(Jumbo)
HEN-673	Hendersons Seeds -	Experimental Line S.673.E
HEN-674	Hendersons Seeds -	Experimental Line S.674.E
HEN-678	Hendersons Seeds -	Experimental Line S.678.G
HEN-681	Hendersons Seeds -	Experimental Line S.681.C
YAT-GLA	Yates Seeds -	Gladiator
YAT-E511	Yates Seeds -	Experimental Line E511
YAT-E515	Yates Seeds -	Experimental Line E515
YAT-E544	Yates Seeds -	Experimental Line E544
YAT-E546	Yates Seeds -	Experimental Line E546
YAT-E547	Yates Seeds -	Experimental Line E547
YAT-Z549	Yates Seeds -	Experimental Line Z549
RS-DIA	Lefroy Valley East -	Royal Sluis - Diamond White
RS-DIAJ	Lefroy Valley East -	Royal Sluis - Diamond White(Jumbo)
RS-135	Lefroy Valley East -	Royal Sluis Experimental Line - 94135
RS-278	Lefroy Valley East -	Royal Sluis Experimental Line - 94278
MKS-326	Magnus Kahl Seeds -	Experimental Line - V50-AND326
MKS-328	Magnus Kahl Seeds -	Experimental Line - V50-AND328
MKS-504	Magnus Kahl Seeds -	Experimental Line - V50-AND504
MKS-069	Magnus Kahl Seeds -	Experimental Line - V50-069
MKS-686	Magnus Kahl Seeds -	Experimental Line - V50-686
MKS-688	Magnus Kahl Seeds -	Experimental Line - V50-688
MKS-817	Magnus Kahl Seeds -	Experimental Line - V50-817
MKS-890	Magnus Kahl Seeds -	Experimental Line - V50-890(Jumbo)
MKS-892	Magnus Kahl Seeds -	Experimental Line - V50-892
MKS-974	Magnus Kahl Seeds -	Experimental Line - V50-974
SG-358	Sandoz Seeds -	Experimental Line - ON 358
NW-ELB	New World -	Early Lockyer Brown
NW-154	New World -	Experimental Line NW154
NW-155	New World -	Experimental Line NW155
NW-157	New World -	Experimental Line NW157

Table 2(a) Number of days to harvest and yield data for plantings 1 and 2.

Variety	Days to Harvest	SALEABLE				REJECTS		
		Picklers	No .1	No. 1 Large	Total	Doubles	Off Types	Purple
22.3.96								
Grs - Gob	173	0.9	9.2	30.0	40.1	10.1	0.7	0.0
Grs - Elb	173	0.1	3.2	55.3	58.5	5.7	4.3	0.1
Els - Gob	173	0.5	5.8	36.0	42.3	5.8	0.2	0.0
Els - Wh	173	0.3	5.5	42.4	48.2	5.2	1.0	0.0
Neu - Gob	181	0.5	8.6	34.3	43.4	13.0	0.3	0.2
Neu - Elw	173	0.3	6.5	38.9	45.6	5.5	2.7	0.0
Lit - Gob	181	0.4	6.8	21.2	28.4	10.5	17.5	1.1
Brk - Elw	181	0.0	1.9	32.9	34.8	4.9	28.8	0.0
Sch -Gob	173	0.3	9.0	36.5	45.8	8.4	1.3	0.6
Sch - Elw	173	0.5	10.7	31.9	43.1	6.4	2.8	0.0
Yat - 515	181	0.4	4.0	41.5	45.9	3.8	1.1	0.0
Yat - 546	NH							
Yat - 547	NH							
Mks - 890	181	0.1	3.8	16.9	20.9	20.5	0.4	0.1
Mks - 892	181	0.2	3.9	18.2	22.3	11.3	0.3	0.0
Sps - 837	181	0.2	8.9	10.6	19.7	4.4	2.4	0.0
LSD - 5%		0.4	3.4	10.7	11.2	4.9	6.6	ns
17.4.96								
Grs - Gob	170	1.0	17.1	35.9	53.9	3.2	0.0	0.0
Grs - Glb	189	0.6	8.2	58.9	67.7	8.1	0.0	0.6
Els - Gob	170	0.2	14.3	31.1	45.7	2.3	0.1	0.2
Els - Wh	170	0.3	15.8	29.5	45.6	2.4	0.0	0.0
Neu - Gob	189	0.4	8.4	48.8	57.5	2.2	0.2	0.2
Neu - Elw	170	0.5	11.4	35.4	47.3	3.3	0.0	0.0
Neu - Wab	189	0.4	14.5	45.1	60.1	1.4	0.0	0.0
Neu - Waw	189	0.5	19.7	34.2	54.5	4.6	1.6	0.0
Lit - Gob	170	0.8	10.8	18.8	30.4	3.0	15.7	1.7
Sch - Gob	170	0.4	15.0	25.6	41.0	3.5	0.6	0.36
Sch - Elw	170	0.6	12.6	27.2	40.5	4.9	1.5	0.0
Yat - 515	189	0.7	7.5	62.2	70.4	3.4	0.0	0.0
Yat - 546	189	0.5	4.0	60.6	65.1	0.3	0.0	0.0
Yat - 547	NH							
Mks - 069	NH							
Mks - 890	189	0.4	6.0	41.4	47.8	10.8	0.0	0.2
Mks - 892	189	0.5	7.9	30.1	38.5	7.3	0.0	0.0
Mks - 326	189	1.7	20.2	2.3	24.2	0.6	0.1	0.0
Mks - 328	189	2.2	19.6	6.2	27.9	0.7	0.7	0.0
Mks - 504	NH							
Sps - 837	189	1.2	14.1	29.2	44.4	1.3	2.2	0.0
New - Elb	170	0.6	12.1	35.3	38.0	3.0	1.1	0.7
New - 157	189	0.8	13.0	42.6	56.5	2.9	0.0	0.0
RS - 135	189	0.7	11.2	34.8	46.7	0.0	0.1	0.0
RS - 278	NH							
LSD - 5%		1.0	8.1	10.8	8.9	3.2	2.4	0.7

Table 3(a) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for plantings 1 and 2.

Variety	Number of Centres	SALEABLE				REJECTS				
		Pickler	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
22.3.96										
Grs - Gob	2.7	5.5	26.0	38.7	70.3	12.9	1.4	0.0	5.5	9.8
Grs - Elb	2.5	1.1	9.8	64.3	75.2	6.5	5.8	0.2	1.8	10.5
Els - Gob	2.8	4.5	19.4	48.9	72.9	8.0	0.2	0.0	4.9	14.0
Els - Wh	2.2	3.0	16.9	50.8	70.8	73.1	1.7	0.0	3.4	16.9
Neu - Gob	2.3	4.2	20.9	39.2	64.3	16.0	1.0	0.2	2.3	16.2
Neu - Elw	2.6	3.6	18.0	47.2	68.7	6.1	3.6	0.0	1.9	19.7
Lit - Gob	2.7	4.2	17.9	24.2	46.2	11.1	20.8	1.6	1.8	18.4
Brk - Elw	2.9	0.4	5.4	30.0	35.8	5.1	40.2	0.0	1.2	17.6
Sch -Gob	2.3	4.3	29.6	48.3	82.3	10.1	2.6	0.7	2.3	2.1
Sch - Elw	3.2	5.8	29.5	40.4	75.7	8.2	4.5	0.0	0.6	11.0
Yat - 515	2.5	3.5	10.4	50.5	64.4	4.3	2.0	0.0	3.5	25.7
Yat - 546	NH									
Yat - 547	NH									
Mks - 890	2.6	1.2	14.6	26.9	42.8	32.7	1.2	0.3	6.9	16.2
Mks - 892	2.1	2.4	11.7	23.4	37.5	13.9	0.6	0.0	0.3	47.7
Sps - 837	2.7	2.4	17.4	20.4	40.2	8.1	2.8	0.0	24.0	24.9
LSD - 5%	ns	ns	8.5	10.8	12.9	4.1	10.1	ns	4.5	9.1
17.4.96										
Grs - Gob	2.5	8.1	43.9	42.1	94.2	3.6	0.0	0.0	0.0	2.2
Grs - Glb	1.6	4.5	21.5	57.7	83.7	7.0	0.0	0.4	0.0	9.0
Els - Gob	2.6	2.7	44.3	40.9	87.9	3.5	0.2	0.8	0.0	7.6
Els - Wh	2.5	3.4	47.1	38.2	86.2	2.9	0.0	0.0	0.0	11.6
Neu - Gob	2.6	3.0	25.7	59.9	88.6	2.1	0.5	0.2	0.0	8.6
Neu - Elw	2.3	5.3	33.9	41.6	80.8	4.2	0.0	0.0	0.2	14.7
Neu - Wab	1.8	3.7	36.2	50.1	90.1	1.4	0.0	0.0	0.2	9.0
Neu -Waw	2.3	3.8	38.2	40.0	90.6	4.8	1.7	0.0	0.0	2.3
Lit - Gob	2.1	7.1	30.9	22.3	60.2	4.1	25.2	3.0	0.0	7.6
Sch - Gob	2.4	3.3	44.2	40.8	88.3	5.2	1.8	0.6	0.0	4.2
Sch - Elw	2.8	5.6	37.1	35.9	78.6	6.9	1.7	0.0	0.0	12.8
Yat - 515	2.0	5.2	21.5	62.3	89.1	3.0	0.0	0.0	0.0	8.0
Yat - 546	2.3	6.0	11.1	63.3	80.5	0.2	0.0	0.0	0.0	19.3
Yat - 547	NH									
Mks - 069	NH									
Mks - 890	2.5	3.9	17.9	53.1	74.8	14.0	0.0	0.2	0.0	10.9
Mks - 892	1.9	4.4	20.8	40.6	65.8	9.8	0.0	0.0	0.0	24.4
Mks - 326	2.1	16.9	70.3	5.1	92.3	1.6	0.5	0.0	4.7	0.9
Mks - 328	2.4	21.5	60.1	12.6	94.3	1.7	1.8	0.0	0.5	1.7
Mks - 504	NH									
Sps - 837	2.2	8.7	36.7	39.8	85.3	1.6	3.9	0.0	0.0	9.2
New - Elb	2.3	5.1	38.2	37.6	80.9	4.4	2.8	2.0	0.0	9.9
New - 157	1.6	5.8	34.0	49.2	89.1	2.9	0.0	0.0	0.4	7.7
RS - 135	1.3	6.0	32.4	44.2	82.6	0.0	0.4	0.0	0.4	16.7
RS - 278	NH									
LSD - 5%	0.4	6.5	16.7	14.3	8.2	3.7	3.4	1.1	1.7	8.0

Table 4(a) Bulb description, soluble solids (SS) and storage data for plantings 1 and 2.

Variety	Shells	TSS (brix %)	Shape	Skin Colour	Soundness %	Black Mould %	Greening Rating**	Firmness	
								Harvest	12 Weeks
22.3.96									
Grs - Gob	2.4	10.5	Globe	Gld Brown	48.3	100.0	3	Firm	Soft
Grs - Elb	2.9	10.1	Flat Globe	Brown	41.7	100.0	1	Firm	Soft
Els - Gob	2.3	9.6	Globe	Gld Brown	51.7	100.0	3	Firm	Soft
Els - Wh	2.0	10.1	Globe	White	6.7	100.0	2.5	Firm	Soft
Neu - Gob	2.6	10.3	Globe	Gld Brown	33.3	100.0	2	Firm	Soft
Neu - Elw	2.5	9.7	Globe	White	6.7	100.0	1	Firm	Soft
Lit - Gob	2.8	10.2	Globe	Brown	28.3	100.0	2	Firm	Soft
Brk - Elw	3.0	9.3	Globe	White	6.7	100.0	2	Firm	Soft
Sch -Gob	2.4	10.7	Flat Globe	Gld Brown	41.7	100.0	2	Firm	Soft
Sch - Elw	2.6	10.7	Flat Globe	White	4.2	57.1	2	Firm	Soft-firm
Yat - 515	2.7	10.8	Globe	Brown	50.0	100.0	2	Firm	Soft
Yat - 546									
Yat - 547									
Mks - 890	3.3	11.5	Globe	Brown	65.0	100.0	1	Firm	Soft
Mks - 892	3.6	9.5	High Globe	Brown	53.3	100.0	2	Firm	Soft
Sps - 837	2.4	10.4	Globe	Red	9.6	25.0	1	Firm	Soft
LSD 5%		ns							
17.4.96									
Grs - Gob	2.6	11.2	Globe	Gld Brown	73.3	95.5	2.5	Firm	Soft
Grs - Glb	3.2	9.5	Globe	Brown	65.0	100.0	1.5	Firm	Soft
Els - Gob	3.0	9.9	Flat Globe	Gld Brown	60.0	100.0	2.5	Firm	Soft
Els - Wh	2.3	11.6	Globe	White	28.3	88.2	2.5	Soft-firm	Soft
Neu - Gob	2.3	10.3	Globe	Gld Brown	76.7	78.7	2	Firm	Soft
Neu - Elw	2.4	10.7	Flat Globe	White	18.3	81.8	3	Firm	Soft
Neu - Wab	2.9	9.5	Globe	Brown	68.3	73.2	1	Firm	Soft
Neu -Waw	2.7	11.3	Globe	White	26.7	56.3	2	Firm	Soft-firm
Lit - Gob	2.3	10.2	Globe	Lt Brown	68.3	95.1	2	Firm	Soft
Sch - Gob	2.3	11.3	Flat Globe	Gld Brown	60.0	100.0	2	Firm	Soft
Sch - Elw	2.2	11.1	Flat Globe	White	38.3	87.0	3	Firm	Soft
Yat - 515	2.7	10.5	Globe	Brown	86.7	80.8	2	Firm	Soft-firm
Yat - 546	3.4	9.6	Globe	Brown	83.3	92.0	2	Firm	Soft
Yat - 547									
Mks - 069									
Mks - 890	2.4	10.5	Globe	Brown	83.3	72.0	1.5	Firm	Soft
Mks - 892	2.4	10.4	Globe	Brown	85.0	74.0	1.5	Firm	Soft
Mks - 326	3.6	20.2	Globe	White	90.0	20.4	1.5	White	Hard
Mks - 328	3.4	18.3	Globe	White	66.7	31.1	2	Firm	Hard
Mks - 504									
Sps - 837	2.2	9.6	Globe	Res	53.3	75.0	1	Firm	Soft
New - Elb	2.9	10.7	Globe	Brown	78.3	100.0	2	Firm	Soft
New -157	3.3	9.2	Globe	Brown	95.0	80.7	2	Firm	Soft
RS - 135	4.0	8.5	High Globe	Brown	48.3	58.6	1	Soft-Firm	V. Soft
RS - 278									
LSD 5%		1.3							

** Greening scale: 1 - nil; 2 - very slight; 3 - slight; 4 - marked; 5 - pronounced.

Table 2(b) Number of days to harvest and yield data for planting 3.

Variety	Days to Harvest	SALEABLE				REJECTS		
		Picklers	No .1	No. 1 Large	Total	Doubles	Off Types	Purple
8.5.96								
Grs - Glb	176	0.8	11.8	44.3	56.8	0.1	0.0	0.3
Neu - Wab	176	1.5	12.8	40.3	56.7	1.3	1.5	0.0
Neu - Waw	176	1.8	17.8	28.0	47.6	1.3	0.8	0.0
Neu - Lw	176	1.5	37.5	8.6	47.5	1.0	0.9	0.0
Yat - 511	189	1.3	3.6	71.0	75.9	0.0	0.5	0.0
Yat - 515	176	0.9	16.5	49.0	66.4	0.0	0.0	0.0
Yat - 544	176	1.0	6.3	67.4	74.7	0.0	0.0	0.0
Yat - 549	176	0.6	7.0	63.4	71.0	0.5	0.3	0.0
Yat - Gla	189	2.0	12.8	32.9	47.7	0.0	0.0	0.0
Mks - 688	189	2.8	22.4	8.1	33.3	3.3	0.3	0.0
Mks - 817	189	1.0	11.2	49.7	61.8	0.9	0.6	0.0
Sps - 778	176	0.9	10.5	58.7	70.2	0.0	0.5	0.2
Sps - 837	189	3.1	19.0	37.7	59.8	0.1	0.9	0.0
Sps - 897	176	0.4	3.1	51.3	54.8	1.0	0.7	0.0
Sps - Pan	176	0.5	13.7	60.4	74.5	0.0	0.2	0.0
New - 154	189	1.6	19.5	48.3	69.4	0.0	0.1	0.1
New - 155	176	1.0	6.9	60.2	68.1	0.0	0.2	0.0
RS - 135	179	1.6	9.0	54.3	64.9	0.0	0.6	0.0
RS - 278	189	1.7	7.3	64.9	73.9	0.1	0.0	0.1
RS - DIA	189	1.2	11.2	43.8	56.3	0.1	0.8	0.0
RS - DIAJ	189	1.0	8.1	47.4	56.6	0.0	1.1	0.0
Hen - 673	189	2.3	7.1	53.0	62.3	0.5	0.4	5.7
Hen - 674	189	1.0	8.3	60.3	69.7	0.8	0.1	0.4
Hen - 678	189	0.8	15.0	40.4	56.2	0.0	2.7	0.0
Hen - 681	176	1.4	10.6	48.5	60.4	0.3	1.4	0.0
LSD 5%		1.1	5.6	9.6	10.1	1.3	1.1	0.3

Table 3(b) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for planting 3.

Variety	Number of Centres	SALEABLE				REJECTS				
		Picklers	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
8.5.96										
Grs - Glb	2.2	7.4	26.0	65.6	99.0	0.2	0.0	0.4	0.0	0.4
Neu - Wab	2.1	13.0	31.0	53.6	97.6	0.9	1.5	0.0	0.0	0.0
Neu -Waw	2.7	13.4	45.0	38.8	97.3	2.0	0.7	0.0	0.0	0.0
Neu - Lw	2.9	11.3	72.4	13.7	97.4	1.6	0.8	0.0	0.0	0.2
Yat - 511	1.5	9.9	9.4	80.0	99.3	0.0	0.7	0.0	0.0	0.0
Yat - 515	2.3	7.3	33.9	58.8	100.0	0.0	0.0	0.0	0.0	0.0
Yat - 544	2.1	9.5	14.5	76.0	100.0	0.0	0.0	0.0	0.0	0.0
Yat - 549	2.6	5.4	19.2	73.8	98.4	0.7	0.6	0.0	0.0	0.3
Yat - Gla	1.9	15.4	31.4	52.3	99.1	0.0	0.0	0.0	0.8	0.2
Mks - 688	2.3	19.7	55.4	12.9	88.0	7.1	0.7	0.0	4.2	0.0
Mks - 817	2.5	7.8	23.7	65.9	97.5	1.4	0.4	0.0	0.0	0.8
Sps - 778	2.2	8.0	20.4	70.9	99.3	0.0	0.5	0.2	0.0	0.0
Sps - 837	2.9	19.7	33.9	45.4	99.0	0.1	0.9	0.0	0.0	0.0
Sps - 897	2.9	4.0	9.2	83.0	96.3	1.6	1.2	0.0	0.0	0.9
Sps - Pan	2.1	5.6	27.3	67.0	99.8	0.0	0.2	0.0	0.0	0.0
New - 154	1.9	12.8	35.3	51.6	99.6	0.0	0.2	0.2	0.0	0.0
New - 155	1.9	8.7	17.9	72.0	98.6	0.0	0.4	0.0	0.0	1.1
RS - 135	1.3	13.8	22.7	62.1	98.5	0.0	1.3	0.0	0.0	0.2
RS - 278	1.3	10.8	17.0	71.6	99.4	0.2	0.0	0.4	0.0	0.0
RS - DIA	2.1	11.4	25.7	60.7	97.8	0.2	1.4	0.0	0.2	0.2
RS - DIAJ	2.7	9.0	20.2	69.3	98.4	0.0	1.6	0.0	0.0	0.0
Hen - 673	1.8	16.0	15.1	57.5	88.7	1.0	0.7	9.0	0.0	0.6
Hen - 674	1.9	6.8	20.7	70.2	97.7	1.0	0.2	0.4	0.0	0.7
Hen - 678	1.8	6.9	32.9	56.2	95.9	0.0	3.8	0.0	0.0	0.3
Hen - 681	2.6	11.9	23.3	62.4	97.6	0.3	1.6	0.0	0.0	0.4
LSD 5%	0.5	6.8	9.6	10.1	4.7	2.5	ns	0.6	ns	ns

Table 4(b) Bulb description, soluble solids (SS) and storage data for planting 3.

Variety	Shells	TSS (brix %)	Shape	Skin Colour	Soundness %	Black Mould %	Greening Rating**	Firmness	
								Harvest	12 Weeks
8.5.96									
Grs - Glb	2.4	9.3	Globe	Brown	85.0	84.3	3	Firm	Soft
Neu - Wab	2.8	8.9	Globe	Brown	75.0	100.0	2	Firm	Soft
Neu - Waw	2.4	9.9	Globe	White	23.3	80.0	1.5	Firm	Soft
Neu - Lw	1.8	11.0	Globe	White	38.3	100.0	2	Firm	Firm
Yat - 511	2.8	9.1	Globe	Brown	80.0	87.5	2	Firm	Soft
Yat - 515	2.1	9.9	Globe	Brown	76.7	95.7	2	Firm	Soft
Yat - 544	2.7	8.8	Globe	Brown	71.7	69.8	2	Firm	Firm
Yat - 549	2.9	8.3	Globe	Brown	85.0	90.2	2	Firm	Soft
Yat - Gla	2.8	10.9	Globe	Brown	100.0	68.3	2	Hard	Hard
Mks - 688	3.6	12.7	Globe	Brown	100.0	95.0	1.5	Firm	Firm
Mks - 817	2.7	9.9	Globe	Brown	991.7	98.2	2	Hard	Soft-Firm
Sps - 778	2.3	9.8	Globe	Brown	90.0	94.4	3	Firm	Soft
Sps - 837	2.1	9.7	Globe	Red	88.3	84.9	1	Firm	Soft-Firm
Sps - 897	2.7	8.6	Globe	Brown	66.7	92.5	2	Soft-firm	Firm
Sps - Pan	2.8	9.1	Flat Globe	Brown	80.0	100.0	2	Firm	Soft
New - 154	2.6	8.5	Flat Globe	Brown	56.7	100.0	2	Soft-firm	Soft-firm
New - 155	2.3	8.5	High Globe	Lt brown	80.0	93.8	3	Firm	Soft-firm
RS - 135	2.6	7.1	Globe	Brown	55.0	66.7	3	Soft	Soft
RS - 278	2.6	8.3	Globe	Brown	83.3	72.0	2.5	Firm	Soft
RS - DIA	2.3	8.7	Globe	White	23.3	21.4	2	Firm	Soft-firm
RS - DIAJ	2.4	9.8	Flat globe	White	23.3	100.0	3	Firm	Soft
Hen - 673	2.3	8.7	Globe	Brown	70.0	100.0	2.5	Firm	Soft
Hen - 674	2.9	7.2	High Globe	Brown	58.3	82.9	2	Firm	Soft
Hen - 678	2.3	7.5	Flat Globe	Red	68.3	87.8	1	Firm	Soft-firm
Hen - 681	2.7	9.6	Globe	White	48.3	82.8	2.5	Firm	Soft-firm
LSD 5%		0.9							

** Greening scale: 1 - nil; 2 - very slight; 3 - slight; 4 - marked; 5 - pronounced.

Table 2(c) Number of days to harvest and yield data for planting 4.

Variety	Days to Harvest	SALEABLE				REJECTS			
		Picklers	No .1	No. 1 Large	Total	Rotten	Doubles	Off Types	Purple
12.9.96									
Yat - 511	154	0.6	3.4	50.7	54.7	16.1	0.3	0.1	0.0
Yat - 544	154	0.6	8.4	52.8	61.8	0.0	0.2	0.0	0.0
Yat - 549	154	1.6	11.1	50.3	63.0	0.0	2.8	0.0	0.6
Yat - Gla	154	1.0	11.2	25.8	38.0	1.7	0.7	0.0	1.2
Mks - 686	181	0.6	7.6	26.3	34.6	0.9	3.3	0.1	0.0
Mks - 688	181	0.5	6.7	8.1	15.2	3.6	18.5	0.2	0.0
Mks - 817	167	0.5	10.8	26.3	37.6	11.5	1.3	0.0	0.0
Mks - 974	181	0.8	9.6	25.3	35.7	0.7	7.9	0.0	0.0
Sps - 778	154	1.0	17.1	32.8	50.8	0.0	0.7	0.6	0.0
Sps - 846	154	1.3	9.3	53.4	64.1	0.0	2.7	0.0	0.0
Sps - 897	154	1.4	11.4	22.6	35.5	0.0	1.3	0.0	0.0
New - 154	167	0.6	7.0	4.4	12.0	24.8	0.0	0.0	0.0
RS - 135	167	0.3	5.0	16.3	21.6	27.4	0.0	0.0	0.0
RS - 278	154	1.1	12.2	47.9	61.3	0.0	0.0	0.0	0.2
RS - DIA	154	0.2	6.2	9.6	16.1	27.1	0.1	0.0	0.0
RS - DIAJ	154	0.3	4.3	11.5	16.1	17.8	0.3	0.1	0.0
Hen - Sam	181	0.2	2.8	25.1	28.0	26.9	0.0	0.0	0.0
S&G - 358	167	0.7	4.6	28.6	34.0	4.4	8.1	4.1	0.0
LSD 5%		ns	3.9	7.2	8.6	5.5	2.5	0.8	0.6

Table 3(c) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for planting 4.

Variety	Number of Centres	SALEABLE				REJECTS					
		Picklers	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Rotten	Seed Heads
12.6.96											
Yat - 511	1.9	7.7	11.3	60.1	79.2	0.4	0.2	0.0	0.0	20.2	0.0
Yat - 544	2.3	5.5	20.4	73.8	99.8	0.2	0.0	0.0	0.0	0.0	0.0
Yat - 549	2.7	12.0	21.9	61.6	95.6	3.9	0.0	0.5	0.0	0.0	0.0
Yat - Gla	2.2	12.3	37.6	44.4	94.3	1.1	0.2	1.5	0.2	2.8	0.0
Mks - 686	1.9	7.0	25.7	44.9	77.6	17.9	0.3	0.0	1.0	1.5	1.7
Mks - 688	2.7	7.4	20.8	16.0	44.3	46.8	1.0	0.0	0.2	7.7	0.0
Mks - 817	3.0	6.7	28.9	41.4	77.0	2.9	0.0	0.0	0.0	20.1	0.0
Mks - 974	2.4	8.9	27.5	41.0	77.4	15.6	0.0	0.0	0.2	6.6	0.2
Sps - 778	2.3	9.2	38.5	49.2	96.9	0.9	1.3	0.0	0.0	0.0	1.0
Sps - 846	1.7	10.8	21.2	64.6	96.6	3.4	0.0	0.0	0.0	0.0	0.0
Sps - 897	2.5	17.0	34.0	46.4	97.4	2.6	0.0	0.0	0.0	0.0	0.0
New - 154	2.0	8.5	20.9	7.3	36.8	0.0	0.0	0.0	0.0	63.2	0.0
RS - 135	1.5	4.0	15.9	24.1	44.0	0.0	0.0	0.0	0.3	55.7	0.0
RS - 278	1.8	9.9	28.7	61.1	97.8	0.0	0.0	0.2	0.0	0.0	0.0
RS - DIA	2.5	3.4	18.6	16.0	38.1	0.4	0.0	0.0	0.0	61.5	0.0
RS - DIAJ	2.8	5.2	17.6	25.7	48.6	0.6	0.3	0.0	0.0	50.5	0.0
Hen - Sam	2.8	2.8	13.4	38.8	55.1	0.0	0.0	0.0	0.6	44.3	0.0
S&G - 358	1.8	7.2	15.1	44.9	67.1	15.9	9.1	0.0	0.2	7.7	0.0
LSD 5%	0.6	ns	8.8	12.2	10.7	3.1	2.2	0.5	ns	11.2	ns

Table 4(c) Bulb description, soluble solids (SS) and storage data for planting 4.

Variety	Shells	TSS (brix %)	Shape	Skin Colour	Soundness %	Black Mould %	Greening Rating**	Firmness	
								Harvest	12 Weeks
12.9.96									
Yat - 511	2.3	6.8	Flat globe	Lt Brown	60.0	88.9	2	Soft	Soft
Yat - 544	2.3	8.8	Globe	Brown	71.7	95.3	2	Firm	Soft
Yat - 549	2.2	8.2	Globe	Lt Brown	73.3	95.5	2	Firm	Soft
Yat - Gla	2.2	10.2	Globe	Brown	91.5	38.5	1	Firm	Hard
Mks - 686	2.8	9.3	Globe	Brown	79.7	31.3	1	Firm	Firm-Hard
Mks - 688	3.1	10.3	Flat Globe	Brown	66.7	42.1	1	Firm	Firm
Mks - 817	2.0	8.2	Globe	Lt Brown	58.3	82.9	2.5	Firm	Firm
Mks - 974	3.3	9.4	Globe	Brown	83.1	32.7	1	Firm	Firm
Sps - 778	2.1	8.3	Flat Globe	Brown	85.0	80.4	3	Firm	Firm
Sps - 846	2.4	8.1	Globe	Brown	75.0	100.0	2	Firm	Soft-firm
Sps - 897	1.9	8.2	Globe	Lt Brown	53.3	100.0	2	Firm	Firm
New - 154	1.7	6.5	Flat Globe	Lt Brown	42.0	76.2	1.5	Soft	Soft
RS - 135	1.9	6.0	Flat Globe	Lt Brown	31.1	78.9	3	Soft	Soft
RS - 278	2.2	8.3	Globe	Lt Brown	83.3	66.0	2	Firm	Soft-firm
RS - DIA	2.0	7.2	Flat Globe	White	38.3	26.1	2.5	Soft-firm	Firm
RS - DIAJ	2.0	7.3	Flat Globe	White	25.4	87.5	3	Soft-Firm	Firm
Hen - Sam	2.4	6.5	Globe	Lt Brown	40.0	91.7	2	Soft	Soft-firm
S&G - 358	2.2	9.0	Globe	Brown	80.0	56.3	1	Firm	Firm
LSD 5%		1.1							

** Greening scale: 1 - nil; 2 - very slight; 3 - slight; 4 - marked; 5 - pronounced.

6.0 Section 3 - 1997 Variety Trial Series

6.1. Introduction

All four planned plantings in the 1997 trial series were successfully completed. This report presents results of each of these plantings. Results will be presented in tables that will contain data on three major areas of assessment. These areas are (i) yield, (ii) percentage make-up of the various bulb categories per plot as well as number of centres per bulb at harvest and (iii) bulb description, soluble solids per bulb (brix %) and storage data. This progress report is designed to allow seed companies to decide which plantings and which varieties they would like to consider for the planned trial series in 1998.

6.2. 1997 participants

Five commercial seed companies, and four local seed growers contributed varieties for assessment. In addition, varieties developed at Gatton Research Station were also entered in various plantings. The seed companies were Lefroy Valley East (Rio Colorado Seeds, USA), Magnus Kahl Seeds (Hazera, Israel), Yates, Rijk Zwaan and Henderson's Seeds. Local seed growers who participated were Tom Else, Reg Neuendorf, Elwyn Litzow and Edgar Schulz.

6.3. Climatic data

The climatic data for 1997 are presented in Table 1 where certain components are compared with corresponding long-term averages.

Table 1 Average maximum and minimum monthly temperatures and monthly rainfall for 1997 as well as monthly daylength range for Gatton Research Station.

Month	Av max temp (^{0}C)		Av min temp (^{0}C)		Rainfall (mm)		Daylength (hrs)
	1997	Long-term	1997	Long-term	1997	Long-term	
January	29.9	29.8	17.9	18.2	49.6	112.5	14.1 - 13.7
February	31.7	30.5	20.5	18.8	70.8	100.0	13.7 - 13.1
March	30.3	28.8	17.0	16.8	14.6	78.2	13.1 - 12.2
April	27.9	26.3	12.8	14.7	16.8	52.1	12.2 - 11.4
May	23.1	22.7	11.5	9.9	65.0	48.0	11.4 - 10.8
June	20.5	22.6	6.9	7.4	14.6	43.4	10.8 - 10.6
July	20.6	20.3	6.3	6.4	11.8	40.3	10.6 - 10.9
August	22.6	21.4	5.2	6.5	4.0	27.7	10.9 - 11.6
September	26.1	24.7	10.8	9.1	44.0	35.6	11.6 - 12.4
October	27.2	27.8	13.6	12.7	113.0	65.8	12.4- -13.0
November	30.1	29.0	17.0	15.8	50.9	75.0	13.0 - 13.9
December	33.4	29.7	19.9	16.6	149.0	99.7	13.9- -14.1

6.4. Testing procedures

In each planting, 2 replicates or plots of each entry were established. Each plot consisted of a pair of single rows (used to determine yield) and a single guard row on either side. Plots were established on beds with 1.5m centres. This year saw the use of seedling transplants for all onion trials. Seed was planted at the nursery at the scheduled field planting time. After a number of weeks in the nursery the seedlings were planted in the field. (See Table 2). Due to a lack of knowledge pertaining to the production of onion transplants the size of the transplants varied from the 2 leaf stage for the first trial to the 4 leaf stage in the final trial.

Table 2 Number of days (weeks) from sowing to transplanting.

Scheduled Planting Date	Nursery Sowing Date	Field Transplanting Date	Number of days from Sowing to Transplanting(weeks)
19th March	19th March	13th May	55 (8)
16th April	16th April	2nd June	74 (10.5)
7th May	8th May	5th August	91 (13)
4th June	7th June	27th August	84 (12)

The use of transplants was aimed at ensuring a plant population of 35 plants/m^2 (350 000 plants per hectare). Plots were 5m long and yield was measured from 4m of each of the single rows leaving a buffer of 0.5m at each end of the plot. Varieties were harvested when 80-100% of the tops were down and allowed to dry in trays before mechanical grading. Several varieties were not harvested due to excessive numbers of seed stems (> 50%) or inability to form bulbs.. These varieties are denoted by NH in the yield data tables.

At harvest, the number of seed stems and bullnecks were counted. When grading, the number of doubles, purples and off-types (off-colours) were recorded as well as the numbers within the pickling, No. 1 and No. 1 large grades. These grades refer to bulb diameters with the pickling grade being 20-40mm, the No.1 grade 40-75mm and No. 1 Large grade being greater than 75mm.

During grading, 20 bulbs were randomly selected from the entire plot. Five of these were used to determine soluble solids (brix%), number of centres per bulb and percentage dry matter. The remaining 15 bulbs were stored in racks to determine the effect of storage on bulb quality. Two weeks after harvest the bulbs were (i) tested for firmness, (ii) rated for colour and (iii) bulb shape was assessed (see Figure 1). After a further 8-12 weeks, the bulbs were assessed for the number of skins (broken, split and complete), soundness (incidence of breakdown), firmness, degree of greening (1 nil - 5 intense) and incidence of sooty or black mould (*Aspergillus niger*).

6.5. Results

Yields expressed in t/ha of saleable onions (picklers, No. 1 grade and No. 1 grade large) as well as yields of reject bulbs (doubles, off-types and coloured) are presented in Tables 3(a) (planting 1), 3(b) (planting 2), 3(c) (planting 3) and 3(d) (planting 4). Similarly, the percentages of bulbs per plot falling into the various categories are presented in Tables 4(a), 4(b), 4(c) and 4(d), additionally number of centres per bulb and seed stem production are presented in Tables 4(a) (planting 1), 4(b) (planting 2), 4(c) (planting 3) and 4(d) (planting 4). Shape, colour, soluble solids (brix%) and storage details from the various plantings are presented in Tables 5(a) (planting 1), 5(b) (planting 2), 5(c) (planting 3) and 5(d) (planting 4).

6.6. General comments

Transplanted onions

In the 1997 trial series the use of transplants was investigated. All variety trials were planted using onion seedlings. This method of planting was used in an attempt to ensure accurate plant populations and a more uniform bulb shape. Several problems were encountered with this method of planting. The initial problem encountered was the incidence of damping off (*Fusarium spp*). This disease was evident in some of the seedling trays and as a result spread to the onions in the field. Plants that completely died off were replanted but even so some varieties still had lower plant densities than was required. It was also discovered that the hybrid varieties produced much more vigorous plants than the open-pollinated varieties. This could be due to one of a number of factors including, hybrid onions have a much more vigorous root system than OP's, hybrid onions in general can produce a larger onion top than OP onions. This resulted in the open-pollinated varieties producing much smaller bulbs than would usually be the case.

Seasonal conditions

Frosts during the week of 23rd to 30th June caused some problems with the onion seedlings. The frost caused severe tip burn in all seedlings for the second and third plantings. Hot humid conditions in November again caused problems with later plantings. These conditions resulted in most varieties maturing too early, particularly the open-pollinated varieties. Downy mildew and thrips continue to be a problem but yield losses were negligible. Thrip damage in storage was quite severe and all varieties were susceptible. This resulted in a bulb quality that would be considered unmarketable in most cases.

Early season varieties (Planting 1 -19th March)

Whites

Litzow's strain of Early Lockyer White was the highest yielding white variety. This strain was originally developed from a Neuendorf strain. The Else strain again performed well and outyielded all Early Lockyer White strains with the exception of the Litzow (Neuendorf) strain.

The only commercial white variety in this planting was the Lefroy Valley experimental line LVO1102. This variety performed quite well and outyielded some of the Early Lockyer White strains.

A large percentage of unmarketable bulbs were produced at this planting time. The combination of seed stems and doubles accounted for the majority of these unmarketable bulbs and ranged from 6.5% (Else White) -18% (Neuendorf Early Lockyer White).

Browns

Golden brown was still the singular most popular variety, although, the majority of browns tested were supplied by commercial seed companies. All Golden Brown strains were sourced from local seed producers. The highest yielding Golden Brown strain was that produced and maintained at the Gatton Research Station. This strain also produced the highest yield overall. The remainder of the Golden Brown strains performed well with Else's strain still having a good appearance.

Early Lockyer Brown was once again featured at this planting but its yield was markedly lower than in previous years.

The outstanding commercial variety in terms of both yield and appearance was the Yates line E515. It has been named Cavalier. This variety shows excellent promise for the early brown onion market. The three lines from Lefroy Valley produced bulb shapes that are currently unacceptable on the Australian domestic market. These varieties also produced low yields. Two varieties from Magnus Kahl Seeds have potential for acceptance on the domestic market. These varieties are V50-781 and V50-913. Both varieties yielded well and have an acceptable bulb shape. The variety V50-890 produced a good bulb but its yield was a little low. The high yield of the variety V50-1213 was negated by its unacceptable bulb shape. All commercial varieties produced more skins than the traditional Golden Brown a trait that is highly sought after on the export market.

Mid-Season Varieties (Planting 2 - 19th April; Planting 3 -7th May)

Whites

The whites in the second planting consisted of Early Lockyer White strains, the Else White strain and one commercial variety from Lefroy Valley. All white varieties had low yields when compared to the first planting. This is most likely due to the fact that they were open-pollinated varieties and as a result transplanting seemed to limit root development and top growth in the field. Brooking's Early Lockyer White strain produced the highest yield of all white varieties tested with the commercial variety, Lefroy Valley LVO1098 producing the next best yield. In general, there was an increase in the percentage of doubles from the first planting. The Lefroy Valley variety was the only selection that did not produce doubles. All varieties broke down badly in storage.
Of the four whites tested in the third planting only two varieties seemed to be suited to this planting time, Gatton Research Station Gladalan White and Lefroy Valley LVO1098. The Lefroy Valley selection LVO1098 produced the best yield. The Gatton Research Station selection of Gladalan White yielded well and had a superior survival rate in storage than the Lefroy Valley selection. The Else white is not suited to a planting this late in the season. Both Henderson's Bolero and Else's White produced a high percentage of pickler bulbs.

Browns

A number of browns were tested in both plantings. Golden Brown sourced locally is still the most popular variety in the early part of this season but there is an increasing number of varieties being developed by the commercial seed companies. Locally, Wallon Brown is still a popular variety late in this season.

In the first of the mid-season plantings the Golden Brown strains suffered from being planted as seedlings. This was due in part to the fact that they did not develop a sufficiently large root system resulting in limited top growth. The best of the Golden Brown strains was Neuendorf's dark Golden Brown. Both the Neuendorf Golden Brown strains had good survival in storage. The varieties that yielded the best were the Lefroy Valley selections LVO1100 and LVO1101. The variety 1100 produced a large percentage of No. 1 Large bulbs. The shape of the bulbs produced by the variety 1101 was quite variable with bulbs ranging in shape from flat globe to high globe. The Yates' variety Cavalier (E515) again produced satisfactory yields. The second Yates' variety ELG was a very poor yielder with a large percentage of pickler bulbs. None of the Rijk Zwaan varieties produced bulbs due to their unsuitability to this planting time.

The majority of varieties entered in the third planting were browns. A number of varieties produced yields in excess of 50 t/ha (20 t/acre). This can be attributed to the fact that there were a large percentage of bulbs greater than 75mm in diameter. These varieties included Yates' hybrids E544, F550 and Z549 and Magnus Kahl Seeds' hybrid V50-1367. Several other varieties produced in excess of 45 t/ha including Henderson's Seeds' hybrid 677G, Lefroy Valley Seeds' hybrids LVO 1095, LVO1100 and LVO1101. The best performed local variety was the Gatton Research Station strain of Gladalan Brown although it did not outperform the best of the commercial varieties.

Reds

Four reds were entered in the mid season trials. In the second planting the Lefroy Valley hybrid LVO1097 was the only selection that produced marketable bulbs. This variety produced the best yield of any variety entered in this planting and shows good potential as an early red variety. The Rijk Zwaan hybrids did not form bulbs. In the third planting both LVO1097 and Red Rojo produced good yields. Both varieties tended to produce flat bulbs which may minimise their acceptance on the red salad onion market.

Late Season Varieties (Planting 4 - 4th June)

Whites

Only one white was entered in this planting, Lefroy Valley Seeds' LVO1102. Its yield was quite low with a large percentage (41.9%) of bulbs produced being of pickler size.

Browns

In general, yields in this planting were quite low. It was felt that the use of transplants was detrimental to all varieties in this planting resulting in large numbers of bulbs that were on the small size. The majority of bulbs classified as No. 1 grade tended to be on the small end of the size scale. The best yielding varieties were the Yates' hybrids E511 and Z549 and the Henderson's variety Samba. These hybrids had a large number of No. 1 Large bulbs. With the exception of the hybrid LVO1096 the Lefroy Valley Seeds selections produced bulbs that would be unacceptable with regards to shape on the domestic market. Both the Wallon Brown and the Gladalan Brown produced yields that were quite low.

Reds

Two red varieties were entered in this planting. Both varieties produced low yields. The Rijk Zwaan hybrid 6 produced a high percentage of doubles and broke down quite severely in storage. The Lefroy Valley hybrid LVO1097 did not yield as well as in previous plantings.

LEGEND

GRS-ELB	Gatton Research Station -	Early Lockyer Brown (Barton Brown)
GRS-ELW	Gatton Research Station -	Early Lockyer White (Barton White)
GRS-GoB	Gatton Research Station -	Golden Brown (Schroedon Brown)
GRS-GLB	Gatton Research Station -	Gladalan Brown (Wallon Brown)
ELS-GoB	Else -	Golden Brown
ELS-WH	Else -	White
NEU-ELW	Neuendorf -	Early Lockyer White
NEU-GoB	Neuendorf -	Golden Brown
NEU-DGoB	Neuendorf -	Dark Golden Brown
NEU-WAB	Neuendorf -	Wallon Brown
NEU-WAW	Neuendorf.-	Wallon White
LIT-ELW(N)	Litzow -	Early Lockyer White(Neuendorf)
LIT-ELW(P)	Litzow -	Early Lockyer White(Pieper)
SCH-ELW	Schulz -	Early Lockyer White
SCH-GoB	Schulz -	Golden Brown
BRK-ELW	Brooking -	Early Lockyer White
HEN-BOL	Hendersons Seeds -	Bolero
HEN-RED	Hendersons Seeds -	Red Rojo
HEN-SAM	Hendersons Seeds -	Samba
HEN-677	Hendersons Seeds -	Experimental Line S.677.G
YAT-CEN	Yates Seeds -	Centurion
YAT-CHR	Yates Seeds -	Chariot
YAT-ELG	Yates Seeds -	Early Lockyer Gold
YAT-GLA	Yates Seeds -	Gladiator
YAT-E511	Yates Seeds -	Experimental Line E511
YAT-E515	Yates Seeds -	Experimental Line E515
YAT-E537	Yates Seeds -	Experimental Line E537
YAT-E540	Yates Seeds -	Experimental Line E540
YAT-E544	Yates Seeds -	Experimental Line E544
YAT-F550	Yates Seeds -	Experimental Line E550
YAT-F555	Yates Seeds -	Experimental Line F555
YAT-F556	Yates Seeds -	Experimental Line F556
YAT-F558	Yates Seeds -	Experimental Line F558
YAT-NW155	Yates Seeds -	Experimental Line NW155
YAT-Z549	Yates Seeds -	Experimental Line Z549
LEF-WEB	Lefroy Valley East -	Western Early Brown
LEF-1095	Lefroy Valley East -	Experimental Line - LVO 1095
LEF-1096	Lefroy Valley East -	Experimental Line - LVO 1096
LEF-1097	Lefroy Valley East -	Experimental Line - LVO 1097
LEF-1098	Lefroy Valley East -	Experimental Line - LVO 1098
LEF-1099	Lefroy Valley East -	Experimental Line - LVO 1099
LEF-1100	Lefroy Valley East -	Experimental Line - LVO 1100
LEF-1101	Lefroy Valley East -	Experimental Line - LVO 1101
LEF-1102	Lefroy Valley East -	Experimental Line - LVO 1102
LEF-1103	Lefroy Valley East -	Experimental Line - LVO 1103
LEF-1104	Lefroy Valley East -	Experimental Line - LVO 1104
LEF-1105	Lefroy Valley East -	Experimental Line - LVO 1105

MKS-757	Magnus Kahl Seeds -	Experimental Line - V50-757
MKS-781	Magnus Kahl Seeds -	Experimental Line - V50-781
MKS-890	Magnus Kahl Seeds -	Experimental Line - V50-890
MKS-913	Magnus Kahl Seeds -	Experimental Line - V50-913
MKS-1213	Magnus Kahl Seeds -	Experimental Line - V50-1213
MKS-1344	Magnus Kahl Seeds -	Experimental Line - V50-1344
MKS-1350	Magnus Kahl Seeds -	Experimental Line - V50-1350
MKS-1367	Magnus Kahl Seeds -	Experimental Line - V50-1367
RZ-1	Rijk Zwaan Seeds -	Experimental Line - 768136
RZ-2	Rijk Zwaan Seeds -	Experimental Line - SI-096
RZ-3	Rijk Zwaan Seeds -	Experimental Line - S-501
RZ-4	Rijk Zwaan Seeds -	Experimental Line - 179765
RZ-5	Rijk Zwaan Seeds -	Experimental Line - 755669
RZ-6	Rijk Zwaan Seeds -	Experimental Line - PR-04
RZ-7	Rijk Zwaan Seeds -	Experimental Line - 343905

Figure 1. Shape of Full Grown Bulbs

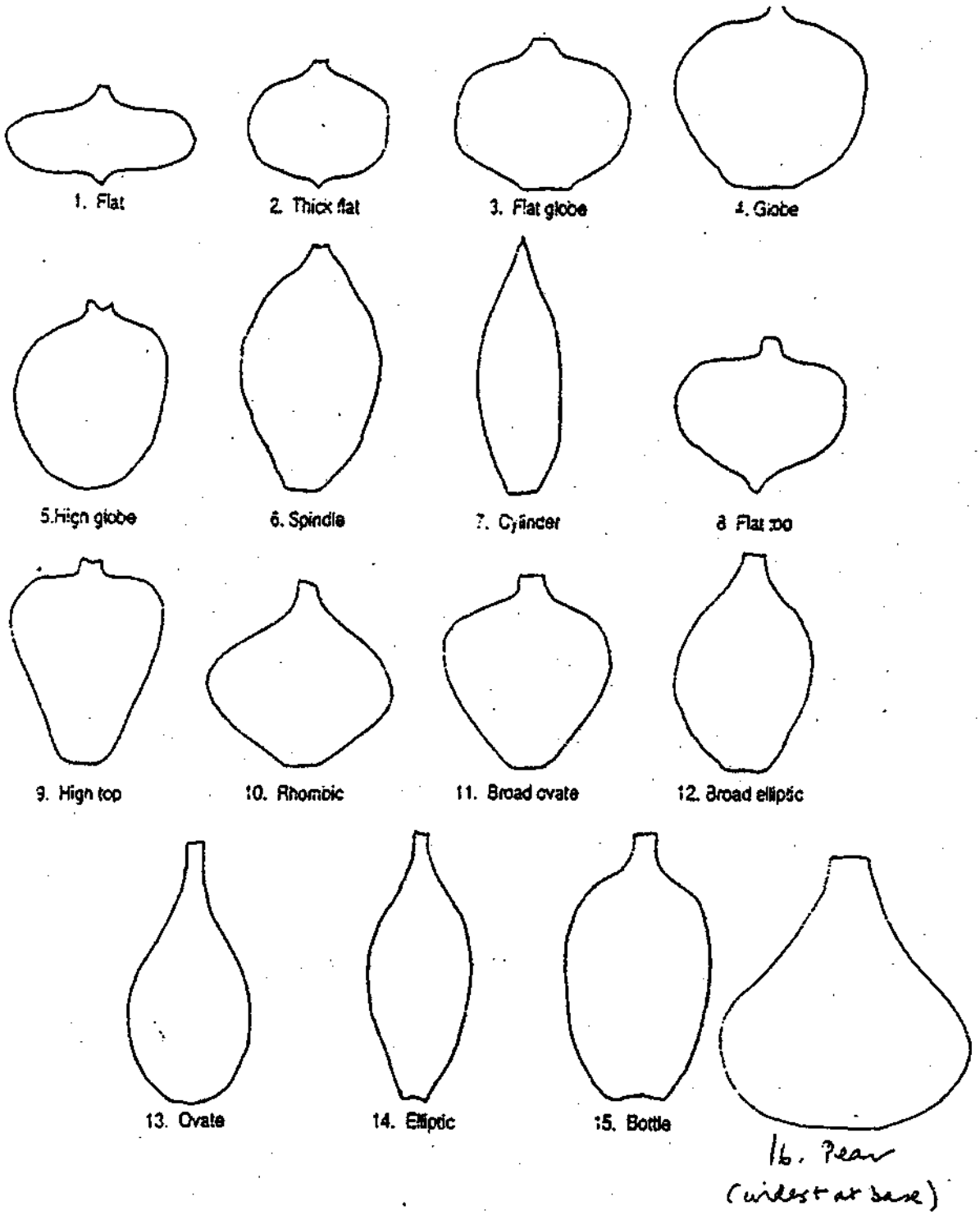

Table 3(a) Number of days to harvest and yield (t/ha) data for the first planting .

Variety	Days to Harvest	SALEABLE				REJECTS		
		Picklers	No .1	No. 1 Large	Total	Doubles	Off Types	Purple
19.3.97								
Lit(N) -	55/141	0.4	25.2	17.9	43.5	2.6	0.0	0
Lit(P) - Elw	55/141	0.6	24.5	5.5	30.5	1.3	1.2	0
Els - Gob	55/154	0.7	20.5	25.9	47.1	3.9	0.0	0
Els - Wh	55/141	0.7	24.6	16.1	41.4	0.9	0.0	0
Sch - Gob	55/141	0.6	26.9	12.0	39.5	0.6	1.8	0
Sch - Elw	55/141	1.1	34.1	3.5	38.7	1.1	1.2	0
Neu - Gob	55/154	0.5	27.7	11.4	39.6	1.8	0.0	0
Neu -Dgob	55/154	0.5	31.2	9.3	44.0	1.0	0.2	0
Neu - Elw	55/141	0.1	23.9	10.1	31.2	3.5	0.5	0
Grs - Gob	55/154	0.6	23.8	25.4	49.8	1.0	0.0	0
Grs - Elw	55/141	0.4	31.0	8.9	40.3	0.0	2.3	0
Grs - Elb	55/149	0.6	29.8	2.4	32.7	1.0	0.2	0
Lef - 1102	55/154	0.6	25.9	14.0	40.4	3.9	0.0	0
Lef - 1103	55/154	3.0	30.5	0.0	33.5	0.4	0.2	0
Lef - 1104	55/154	0.6	26.6	7.4	34.6	1.4	0.0	0
Lef - 1105	55/154	0.5	22.3	14.2	37.0	2.7	0.0	0
Mks - 757	55/154	0.5	27.6	8.5	36.5	2.1	0.0	0
Mks - 781	55/154	0.4	14.0	25.5	39.9	2.6	0.0	0
Mks - 890	55/154	0.3	26.4	8.8	35.4	1.3	0.2	0.1
Mks - 913	55/154	0.2	25.4	18.8	44.4	2.1	0.0	0
Mks - 1213	55/154	0.8	27.1	15.7	43.7	0.0	0.0	0
Yat - E515	55/154	0.1	14.4	34.6	49.1	1.0	0.0	0
LSD - 5%		ns	7.6	12.1	10.3	ns	0.6	ns

Table 4(a) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for the first planting.

Variety	Number of Centres	SALEABLE				REJECTS				
		Pickler	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
19.3.97										
Lit(N) - Elw	1.6	2.6	57.7	26.8	87.2	4.1	0.0	0.0	0.0	8.7
Lit(P) - Elw	1.6	3.9	60.7	24.5	89.0	2.3	2.9	0.0	0.0	5.8
Els - Gob	2.1	4.7	49.4	37.8	91.9	6.7	0.0	0.0	0.0	1.4
Els - Wh	1.7	4.9	62.2	26.4	93.5	1.6	0.0	0.0	0.0	4.9
Sch - Gob	2.0	4.8	66.4	20.7	92.0	1.1	4.5	0.0	0.0	2.4
Sch - Elw	2.2	6.3	81.4	5.3	93.1	3.2	1.6	0.0	0.0	2.1
Neu - Gob	2.1	3.3	71.3	18.9	93.5	4.3	0.0	0.0	0.0	2.2
Neu - DGob	2.1	2.7	79.3	13.9	95.9	1.9	0.5	0.0	0.9	0.9
Neu - Elw	1.9	1.1	62.9	18.6	82.6	7.6	0.5	0.0	0.0	9.2
Grs - Gob	1.8	4.7	55.2	37.3	97.2	1.4	0.0	0.0	0.0	1.4
Grs - Elw	1.4	2.1	75.3	14.5	91.9	0.0	5.6	0.0	0.0	2.5
Grs - Elb	1.8	5.0	85.1	4.4	94.5	1.6	0.6	0.0	0.0	3.3
Lef - 1102	1.6	3.8	65.0	24.0	92.7	2.0	0.0	0.0	0.0	5.3
Lef - 1103	1.8	15.8	79.2	0.0	95.0	1.0	0.5	0.0	0.0	3.5
Lef - 1104	1.7	4.9	73.6	12.4	90.9	3.2	0.0	0.0	5.3	0.6
Lef - 1105	2.1	3.9	59.5	26.7	90.1	5.8	0.0	0.0	0.0	4.0
Mks - 757	1.2	2.2	68.5	13.5	84.3	4.8	0.0	0.0	0.0	10.9
Mks - 781	1.7	3.7	52.0	37.5	93.2	5.8	0.0	0.0	0.0	1.0
Mks - 890	2.3	1.6	73.0	16.5	91.1	3.9	0.6	0.5	0.0	3.9
Mks - 913	1.9	1.6	59.4	31.3	92.3	3.8	0.0	0.0	0.0	3.9
Mks - 1213	1.5	5.7	66.4	27.4	99.5	0.0	0.0	0.0	0.5	0.0
Yat - E515	2.1	2.8	54.4	36.1	93.3	3.7	0.0	0.0	1.9	1.2
LSD - 5%	0.5	ns	19.1	21.0	7.3	ns	1.8	ns	ns	4.6

Table 5(a) Bulb description, soluble solids (SS) and storage data for the first planting.

Variety	Shells	TSS (brix %)	Shape	Skin Colour	Soundness %	Black* Mould %	Greening Rating**	Firmness	
								Harvest	12 Weeks
19.3.97									
Lit(N) - Elw	2.0	6.3	3-4	White	6.7	0.0	1	Firm	Soft
Lit(P) - Elw	2.0	6.0	3	White	6.7	100.0	1	Soft-firm	Soft
Els - Gob	2.0	6.3	4	Gld Brown	20.0	0.0	1	Firm	Soft
Els - Wh	m	6.4	4	White	0.0	na	1	Soft-firm	na
Sch - Gob	2.5	6.6	2	Gld Brown	43.3	23.1	2	Firm	Soft
Sch - Elw	1.5	6.8	2	White	13.3	0.0	1.5	Soft-firm	Soft
Neu - Gob	2.1	7.1	3	Gld brown	40.0	33.3	1	Soft-firm	Soft-firm
Neu - DGob	2.2	6.4	3	Dk GlBrown	43.3	53.8	1	Soft-firm	Soft
Neu - Elw	m	6.2	4	White	0.0	na	1	Soft-firm	na
Grs - Gob	2.1	6.3	3	Gld brown	30.0	33.3	2	Soft-firm	Soft-firm
Grs - Elw	1.7	6.2	4	White	36.7	9.1	2	Soft-firm	Soft-firm
Grs - Elb	1.4	6.2	3	Brown	50.0	13.3	1	Soft-firm	Soft-firm
Lef - 1102	2.5	7.0	4	White	13.3	50.0	1	Firm	Soft-firm
Lef - 1103	2.3	6.4	1	Brown	13.3	50.0	1	Soft-firm	Soft
Lef - 1104	3.4	6.1	11	Dk Brown	26.7	75.0	1	Soft-firm	Soft
Lef - 1105	2.4	6.0	2	Dk Brown	23.3	57.1	1	Soft-firm	Soft-firm
Mks - 757	2.4	7.0	2	Brown	46.7	7.1	1	Soft-firm	Soft-firm
Mks - 781	3.2	6.9	3	Dk Brown	33.3	60.0	1	Firm	Soft-firm
Mks - 890	2.5	6.3	3,5	Dk Brown	33.3	70.0	1	Firm	Soft-firm
Mks - 913	2.4	6.9	3	Brown	56.7	70.6	1	Firm	Soft-firm
Mks - 1213	2.5	6.7	10	Dk Brown	73.3	13.6	1	Hard	Firm-hard
Yat - E515	3.0	6.3	3	Brown	30.0	100.0	1	Firm	Soft
LSD - 5%		ns							

* Percentage calculated from number of sound bulbs

** Greening scale: 1 - nil; 2 - very slight; 3 - slight; 4 - marked; 5 - pronounced.

Table 3(b) Number of days to harvest and yield (t/ha) data for the second planting .

Variety	Days to Harvest	SALEABLE				REJECTS		
		Picklers	No .1	No. 1 Large	Total	Doubles	Off Types	Purple
19.4.97								
Lit(N) - Elw	74/134	0.4	16.0	10.9	27.3	0.7	0.0	0.0
Lit(P) - Elw	74/134	1.0	18.5	5.5	25.0	0.9	0.5	0.0
Els - Gob	74/134	1.3	16.3	5.8	23.3	2.3	0.0	0.0
Els - Wh	74/134	1.7	15.2	4.9	21.8	0.9	0.1	0.0
Sch - Gob	74/134	1.1	14.1	0.3	15.5	0.2	0.4	0.0
Sch - Elw	74/134	1.0	14.1	0.6	15.7	0.3	1.9	0.0
Neu - Gob	74/137	1.4	14.1	2.3	17.8	1.1	0.2	0.0
Neu - DGob	74/134	1.3	22.0	3.9	27.2	1.0	0.0	0.0
Neu - Elw	74/134	1.0	14.4	4.4	19.8	0.8	0.3	0.0
Neu - Wab	74/144	0.3	8.9	15.2	24.4	0.4	0.0	0.2
Brk - Elw	74/134	0.6	17.2	18.4	36.2	1.1	0.0	0.0
Grs - Gob	74/134	1.2	16.1	3.8	21.0	2.4	0.0	0.0
Grs - Elw	74/134	1.9	14.8	0.7	17.5	0.3	0.3	0.0
Lef - 1095	74/163	0.3	10.6	25.0	35.9	0.0	0.0	0.0
Lef - 1096	74/137	1.4	18.3	9.1	28.8	1.3	0.0	0.0
Lef - 1097	74/163	0.1	17.9	31.8	49.8	1.4	0.0	0.0
Lef - 1098	74/163	0.4	17.9	14.5	32.8	0.0	0.0	0.0
Lef - 1099	74/144	1.3	20.3	2.7	24.3	1.4	0.0	0.0
Lef - 1100	74/163	0.3	7.1	31.8	39.2	1.2	0.0	0.7
Lef - 1101	74/144	0.5	13.0	24.8	38.3	2.9	0.0	0.0
Yat - Elg	74/144	1.3	10.8	3.0	15.1	0.5	0.3	0.0
Yat - E515	74/144	0.7	12.2	24.8	37.7	0.2	0.0	0.0
RZ - 1	NH							
RZ - 2	NH							
RZ - 3	NH							
RZ - 4	NH							
RZ - 5	NH							
RZ - 6	NH							
RZ - 7	NH							
LSD - 5%		0.8	6.9	13.5	12.5	ns	ns	ns

Table 4(b) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for the second planting.

Variety	Number of Centres	SALEABLE				REJECTS				
		Pickler	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
19.4.97										
Lit(N) - Elw	1.8	6.6	64.1	23.4	94.1	5.1	0.0	0.0	0.7	
Lit(P) - Elw	2.0	11.7	65.9	12.0	89.6	8.3	1.4	0.0	0.7	
Els - Gob	1.8	15.9	56.6	13.0	85.5	13.7	0.0	0.0	0.7	
Els - Wh	1.6	21.6	58.2	11.2	91.0	8.2	0.7	0.0	0.0	
Sch - Gob	1.8	18.3	75.1	0.9	94.4	1.9	2.8	0.0	1.0	
Sch - Elw	1.7	16.6	68.9	1.6	87.0	3.8	8.2	0.0	0.9	
Neu - Gob	1.8	15.2	71.3	7.1	93.6	5.6	0.8	0.0	0.0	
Neu - DGob	2.0	12.9	74.7	7.7	95.3	4.7	0.0	0.0	0.0	
Neu - Elw	1.6	14.6	67.5	12.8	94.9	4.3	0.9	0.0	0.0	
Neu - Wab	2.0	5.2	46.4	43.8	95.5	3.3	0.0	1.2	0.0	
Brk - Elw	1.8	5.0	53.9	35.6	94.5	4.3	0.0	0.0	1.2	
Grs - Gob	1.5	15.9	62.1	9.0	86.9	13.1	0.0	0.0	0.0	
Grs - Elw	2.0	25.5	67.1	2.5	95.1	3.3	1.6	0.0	0.0	
Lef - 1095	1.6	3.3	35.9	60.8	100.0	0.0	0.0	0.0	0.0	
Lef - 1096	2.1	13.8	63.4	19.3	96.6	3.4	0.0	0.0	0.0	
Lef - 1097	1.8	0.6	48.4	47.8	96.8	3.2	0.0	0.0	0.0	
Lef - 1098	1.8	5.2	63.6	31.3	100.0	0.0	0.0	0.0	0.0	
Lef - 1099	1.1	12.1	72.6	6.3	91.0	8.0	0.0	0.0	0.9	
Lef - 1100	1.4	3.8	27.7	63.4	94.9	3.7	0.0	1.5	0.0	
Lef - 1101	1.0	5.4	40.8	46.0	92.1	7.9	0.0	0.0	0.0	
Yat - Elg	2.3	21.0	62.6	10.1	93.7	4.2	0.9	0.0	1.2	
Yat - E515	2.0	11.1	41.2	46.4	98.7	1.3	0.0	0.0	0.0	
RZ - 1	NH									
RZ - 2	NH									
RZ - 3	NH									
RZ - 4	NH									
RZ - 5	NH									
RZ - 6	NH									
RZ - 7	NH									
LSD - 5%		9.4	21.6	21.7	ns	ns	ns	ns	ns	

Table 5(b) Bulb description, soluble solids (SS) and storage data for the second planting.

Variety	Shells	TSS (brix %)	Shape	Skin Colour	Soundness %	Black* Mould %	Greening Rating**	Firmness	
								Harvest	12 Weeks
19.4.97									
Lit(N) - Elw	1.4	6.2	3	White	16.7	0.0	1	Firm	Firm
Lit(P) - Elw	1.7	6.0	3	White	26.7	37.5	1	Firm	Soft-firm
Els - Gob	2.0	6.4	3	Gld Brown	26.7	0.0	2	Firm	Firm
Els - Wh	2.0	7.1	4	White	3.3	0.0	1	Firm	Firm
Sch - Gob	1.8	6.5	4	Gld Brown	43.3	46.2	3	Soft-firm	Firm
Sch - Elw	1.7	6.7	2	White	33.3	0.0	1	Soft-firm	Soft-firm
Neu - Gob	2.1	6.4	4	Gld Brown	73.3	9.1	2	Soft-firm	Soft-firm
Neu - DGob	2.1	6.8	4	Gld Brown	66.7	35.0	2	Soft-firm	Soft-firm
Neu - Elw	1.5	6.3	3	White	13.3	0.0	2	Firm	Soft-firm
Neu - Wab	2.8	6.1	3	Br-Dk Brown	46.7	57.1	1	Firm	Firm
Brk - Elw	1.9	6.4	3-4	White	23.3	0.0	2	Firm	Soft-firm
Grs - Gob	2.1	5.8	3	Gld Brown	23.3	0.0	2	Soft-firm	Soft-firm
Grs - Elw	1.8	6.8	4	White	26.7	12.5	1	Firm	Soft-firm
Lef - 1095	2.5	6.5	3-4	Brown	13.3	25.0	1	Firm	Firm
Lef - 1096	2.1	6.2	3	Brown	50.0	53.3	1	Firm-hard	Firm
Lef - 1097	1.8	6.2	2	Red	23.3	0.0	1	Firm	Soft-firm
Lef - 1098	1.7	5.7	3	White	10.0	66.7	1	Firm	Firm
Lef - 1099	2.1	6.2	2	Dk Brown	26.7	12.5	1	Firm	Firm
Lef -1100	2.0	6.0	4	Lt Brown	36.7	63.6	1	Firm	Soft-firm
Lef - 1101	2.8	5.5	3,4,5	Brown	40.0	50.0	1	Firm	Firm
Yat - Elg	2.1	6.4	5	Lt Brown	73.3	18.2	1	Firm	Firm
Yat - E515	2.4	5.2	3	Brown	26.7	75.0	2	Hard	Firm
RZ - 1	NH								
RZ - 2	NH								
RZ - 3	NH								
RZ - 4	NH								
RZ - 5	NH								
RZ - 6	NH								
RZ - 7	NH								
LSD - 5%		ns							

* Percentage calculated from number of sound bulbs.

** Greening scale: 1 - nil; 2 - very slight; 3 - slight; 4 - marked; 5 - pronounced.

Table 3(c) Number of days to harvest and yield (t/ha) data for the third planting .

Variety	Days to Harvest	SALEABLE				REJECTS		
		Picklers	No .1	No. 1 Large	Total	Doubles	Off Types	Purple
7.5.97								
Els - Gob	91/80	3.5	14.5	0.6	18.6	0.9	0.0	0.0
Els - Wh	91/80	3.4	11.6	0.0	15.0	0.6	0.0	0.0
Sch - Gob	91/80	5.9	10.2	0.0	16.1	0.2	0.2	0.0
Neu - Gob	91/80	4.1	16.3	0.0	20.4	0.0	0.0	0.0
Neu - DGob	91/80	3.2	17.1	0.0	20.3	0.2	0.1	0.0
Neu - Wab	91/80	3.0	22.8	1.4	27.2	0.1	0.0	0.1
Grs - Glb	91/99	1.1	24.7	14.8	40.6	0.1	0.0	0.6
Grs - Glw	91/99	1.8	23.4	9.0	34.2	2.5	0.0	0.0
Lef - 1095	91/99	2.1	17.8	29.0	48.9	0.0	0.0	0.0
Lef - 1096	91/80	2.2	25.6	1.9	29.7	0.2	0.0	0.0
Lef - 1097	91/99	0.5	28.1	22.0	50.6	4.9	0.0	0.0
Lef - 1098	91/99	0.3	27.4	14.5	42.2	0.3	0.0	0.0
Lef - 1099	91/99	1.7	30.7	5.0	37.4	0.0	0.0	0.0
Lef - 1100	91/99	0.4	18.9	27.8	47.1	0.0	0.4	1.2
Lef - 1101	91/99	0.6	16.6	31.1	48.3	0.3	0.0	0.0
Mks - 1344	91/99	1.8	15.2	23.1	40.1	0.0	0.0	0.0
Mks - 1350	91/99	1.3	20.5	23.4	45.2	0.0	0.0	0.0
Mks - 1367	91/99	0.7	13.8	37.0	51.5	0.0	0.0	0.0
Yat - Cen	91/99	0.4	26.4	17.7	44.5	1.4	0.0	0.0
Yat - Elg	91/80	3.4	17.8	0.0	21.2	0.1	0.0	0.2
Yat - E537	91/99	0.4	27.7	11.1	39.2	0.8	0.0	0.0
Yat - E544	91/99	0.7	15.1	34.8	50.7	0.0	0.0	0.0
Yat - F550	91/99	0.2	16.0	42.8	59.0	0.5	0.0	0.0
Yat - F555	91/99	0.3	24.7	20.0	45.0	0.9	0.0	0.0
Yat - NW155	91/80	2.4	23.8	1.1	27.3	0.2	0.0	0.0
Yat - Z549	91/99	0.1	14.9	39.6	54.6	2.4	0.0	0.0
RZ - 6	91/114	0.9	13.5	12.3	26.7	5.1	0.0	0.0
Hen - Bol	91/99	2.9	17.6	4.9	25.5	0.1	1.2	0.0
Hen - Red	91/99	0.8	24.1	22.1	47.0	0.8	0.0	0.0
Hen - 677G	91/99	0.8	23.1	21.3	45.0	0.2	0.2	0.0
LSD - 5%		1.3	6.5	11.2	9.8	1.1	ns	ns

Table 4(c) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for the third planting.

Variety	Number of Centres	SALEABLE				REJECTS				
		Pickler	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
7.5.97										
Els - Gob	1.7	31.9	60.7	1.2	93.8	6.2	0.0	0.0		
Els - Wh	1.7	41.9	54.7	0.0	96.5	3.5	0.0	0.0		
Sch - Gob	1.6	55.0	43.8	0.0	98.8	0.6	0.6	0.0		
Neu - Gob	1.7	35.0	65.0	0.0	100.0	0.0	0.0	0.0		
Neu - DGob	2.0	28.7	69.5	0.0	98.2	1.2	0.6	0.0		
Neu - Wab	1.8	23.8	72.6	2.6	98.9	0.5	0.0	0.0		
Grs - Glb	1.9	7.3	66.4	24.1	97.8	0.5	0.0	1.6		
Grs - Glw	2.0	14.3	65.8	14.8	94.9	5.1	0.0	0.0		
Lef - 1095	1.1	5.2	47.9	46.9	100.0	0.0	0.0	0.0		
Lef - 1096	1.6	19.3	76.6	3.6	9.5	0.5	0.0	0.0		
Lef - 1097	2.1	4.0	58.9	29.3	92.2	7.8	0.0	0.0		
Lef - 1098	1.9	3.5	72.0	24.0	99.5	0.5	0.0	0.0		
Lef - 1099	1.5	13.1	79.4	7.5	100.0	0.0	0.0	0.0		
Lef - 1100	1.8	3.6	49.2	42.6	95.4	0.0	1.5	3.0		
Lef - 1101	1.2	5.5	44.2	49.7	99.5	0.5	0.0	0.0		
Mks - 1344	2.1	14.6	49.0	36.4	100.0	0.0	0.0	0.0		
Mks - 1350	2.1	12.6	54.6	32.8	100.0	0.0	0.0	0.0		
Mks - 1367	1.6	7.1	37.7	55.2	100.0	0.0	0.0	0.0		
Yat - Cen	1.5	3.5	66.6	29.4	99.5	0.5	0.0	0.0		
Yat - Elg	1.9	32.4	66.5	0.0	98.9	0.5	0.0	0.6		
Yat - E537	2.1	3.0	74.9	20.1	98.0	2.0	0.0	0.0		
Yat - E544	1.7	7.7	38.9	53.4	100.0	0.0	0.0	0.0		
Yat - F550	1.9	2.0	37.2	59.8	99.0	1.0	0.0	0.0		
Yat - F555	1.8	3.0	62.3	32.8	98.0	2.0	0.0	0.0		
Yat - NW155	1.0	19.6	77.7	2.1	99.5	0.5	0.0	0.0		
Yat - Z549	2.1	1.1	37.6	57.7	96.4	3.6	0.0	0.0		
RZ - 6	2.2	11.6	27.9	45.1	84.5	15.5	0.0	0.0		
Hen - Bol	1.7	26.8	60.2	9.9	96.9	0.6	2.5	0.0		
Hen - Red	1.9	7.9	57.2	33.3	98.4	1.6	0.0	0.0		
Hen - 677G	1.6	6.9	60.2	32.0	99.0	0.5	0.5	0.0		
LSD - 5%	0.5	10.1	16.0	14.7	3.7	3.1	0.9	ns		

Table 5(c) Bulb description, soluble solids (SS) and storage data for the third planting.

Variety	Shells	TSS (brix %)	Shape	Skin Colour	Soundness %	Black* Mould %	Greening	Firmness	
								Harvest	12 Weeks
7.5.97									
Els - Gob	1.9	6.0	3-4	Gld Brown	23.3	14.3	1	Firm	Firm
Els - Wh	2.2	6.1	3-4	White	20.0	50.0	1	Firm	Firm
Sch - Gob	2.0	6.7	3-4	Gld Brown	73.3	54.5	2	Firm	Firm
Neu - Gob	2.1	6.4	3	Gld Brown	60.0	33.3	2	Firm	Firm
Neu - DGob	2.3	6.3	3	Gd Br-Brown	60.0	16.7	1	Firm	Firm
Neu - Wab	2.6	6.0	4-5	Brown	26.7	37.5	1	Firm	Soft-Firm
Grs - Glb	1.6	5.7	3-4	Brown	80.0	29.2	1	Firm-hard	Firm-hard
Grs - Glw	1.8	6.6	3-4	White	53.3	12.5	1	Firm	Soft-firm
Lef - 1095	2.2	5.4	5	Lt Brown	73.3	20.0	2	Firm	Firm
Lef - 1096	2.1	6.6	3-4	Lt Brown	60.0	50.0	1	Firm	Firm
Lef - 1097	2.2	8.2	2	Red	46.7	0.0	1	Firm	Firm
Lef - 1098	2.6	6.2	3	White	30.0	33.3	1	Firm-hard	Firm
Lef - 1099	2.1	6.3	2	Brown	80.0	29.2	1	Firm-hard	Firm
Lef - 1100	2.1	5.6	3	Lt Br-Brown	56.7	35.3	1	Firm-hard	Firm
Lef - 1101	2.3	5.6	4	Lt Br-Brown	86.7	23.1	1.5	Hard	Firm
Mks - 1344	1.9	7.2	3	Lt Brown	76.7	21.7	1	Firm-hard	Firm-hard
Mks - 1350	2.1	6.5	2-3	Lt Brown	66.7	55.0	1.5	Firm-hard	Firm-hard
Mks - 1367	2.2	6.2	3-4	Lt Br-Brown	86.7	11.5	1	Firm-hard	Firm-hard
Yat - Cen	2.2	8.6	4	Brown	63.3	78.9	1	Hard	Firm-hard
Yat - Elg	2.2	6.0	4	Gld Brown	56.7	35.3	1	Firm	firm
Yat - E537	3.2	8.9	4,5,12	Brown	50.0	73.3	1	Firm-hard	Firm
Yat - E544	2.5	5.9	4	Brown	46.7	71.4	2	Firm-hard	Soft-firm
Yat - F550	1.9	6.6	3	Brown	56.7	76.5	1	Firm	Firm
Yat - F555	2.9	8.9	4-5	Brown	76.7	60.9	1	Hard	Hard
Yat - NW155	2.0	6.3	5	Lt Br-Brown	56.7	29.4	1	Firm	Firm
Yat - Z549	2.1	6.2	4	Lt Brown	46.7	78.6	2	Firm	Firm
RZ - 6	2.5	7.0	2,12	Red	0.0	na	1	Firm	Soft-firm
Hen - Bol	1.8	6.9	3	White	16.7	0.0	1	Firm-hard	Firm
Hen - Red	2.8	6.6	2	Red	56.7	47.1	1	Firm	Soft-firm
Hen - 677G	2.5	5.4	5	Lt Brown	56.7	23.5	1	Firm	Firm
LSD - 5%		1.3							

* Percentage calculated from number of sound bulbs.

** Greening scale: 1 - nil; 2 - very slight; 3 - slight; 4 - marked; 5 - pronounced.

Table 3(d) Number of days to harvest and yield (t/ha) data for the fourth planting .

Variety	Days to Harvest	SALEABLE				REJECTS		
		Picklers	No .1	No. 1 Large	Total	Doubles	Off Types	Purple
4.6.97								
Neu - Wab	84/77	3.4	6.1	1.3	10.8	0.2	0.0	0.4
Grs - Glb	84/77	2.9	18.2	3.1	24.2	0.6	0.0	0.9
Lef - Web	84/77	1.4	22.0	4.3	27.7	1.3	0.4	0.6
Lef - 1096	84/77	2.2	25.0	2.5	29.6	0.2	0.0	0.0
Lef - 1097	84/77	1.8	23.5	3.6	28.9	3.4	0.0	0.3
Lef - 1099	84/77	2.0	26.7	2.1	30.8	0.0	0.0	0.0
Lef - 1102	84/77	4.7	15.9	0.2	20.8	0.0	0.6	0.0
Lef - 1103	84/77	2.0	31.3	1.0	34.2	0.0	0.3	0.0
Lef - 1104	84/77	3.6	21.2	2.6	24.5	0.5	0.0	0.0
Lef - 1105	84/77	1.5	26.9	2.0	30.4	0.0	0.0	0.0
Yat - Cen	84/92	0.9	26.7	3.6	31.2	0.0	0.0	0.0
Yat - Chr	84/92	2.9	20.5	4.0	27.4	1.4	0.0	0.0
Yat - Gla	84/92	0.9	25.6	3.7	30.3	1.6	0.0	0.0
Yat - E511	84/92	1.3	13.6	24.5	39.4	0.0	0.0	0.0
Yat - E537	84/92	0.7	29.7	3.2	33.6	0.8	0.0	0.0
Yat - E540	84/92	0.8	28.7	3.1	32.6	0.5	0.0	0.0
Yat - E544	84/77	1.3	17.9	8.0	27.2	0.0	0.0	0.0
Yat - F550	84/77	1.6	20.2	8.4	30.2	0.0	0.2	0.0
Yat - F555	84/77	0.9	28.0	2.9	31.8	2.1	0.0	0.0
Yat - F556	84/92	0.9	27.6	5.7	31.2	0.0	0.0	0.0
Yat - F558	84/92	1.2	27.5	5.7	34.3	0.2	0.0	0.0
Yat - Z549	84/77	1.2	20.2	14.9	36.2	1.1	0.2	0.0
RZ - 6	84/92	0.8	23.4	2.8	26.9	6.7	0.0	0.0
Hen - Sam	84/92	1.2	23.7	12.1	37.0	0.0	0.0	0.0
LSD - 5%		1.1	5.9	5.4	7.1	1.5	ns	0.4

Table 4(d) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for the fourth planting.

Variety	Number of Centres	SALEABLE				REJECTS				
		Pickler	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
4.6.97										
Neu - Wab	1.9	41.6	51.8	3.3	96.8	1.3	0.0	2.0		
Grs - Glb	1.7	23.2	66.5	6.0	95.7	1.6	0.0	2.7		
Lef - Web	2.1	12.1	72.5	8.8	93.4	2.7	1.6	1.2		
Lef - 1096	1.8	15.6	79.0	5.0	99.5	0.5	0.0	0.0		
Lef - 1097	1.4	17.6	66.6	6.5	90.6	8.7	0.0	0.6		
Lef - 1099	1.8	19.0	76.7	4.3	100.0	0.0	0.0	0.0		
Lef - 1102	1.3	41.9	55.9	0.5	98.3	0.0	1.7	0.0		
Lef - 1103	1.7	12.9	84.1	2.0	99.0	0.0	1.0	0.0		
Lef - 1104	1.8	27.3	66.7	5.1	99.0	1.0	0.0	0.0		
Lef - 1105	1.6	14.8	81.2	4.0	100.0	0.0	0.0	0.0		
Yat - Cen	1.6	10.1	82.1	7.8	100.0	0.0	0.0	0.0		
Yat - Chr	1.5	25.9	63.3	7.4	96.5	3.5	0.0	0.0		
Yat - Gla	1.2	9.5	79.4	6.7	95.6	4.4	0.0	0.0		
Yat - E511	1.5	13.0	45.2	41.8	100.0	0.0	0.0	0.0		
Yat - E537	1.5	6.2	86.1	5.7	98.0	2.0	0.0	0.0		
Yat - E540	1.7	6.4	84.6	6.3	97.3	2.7	0.0	0.0		
Yat - E544	1.6	14.8	65.1	20.1	100.0	0.0	0.0	0.0		
Yat - F550	1.2	17.2	64.6	17.6	99.4	0.0	0.6	0.0		
Yat - F555	1.9	6.7	82.3	5.5	94.5	5.5	0.0	0.0		
Yat - F556	1.9	6.7	82.7	10.6	100.0	0.0	0.0	0.0		
Yat - F558	1.2	9.3	79.9	10.3	99.5	0.5	0.0	0.0		
Yat - Z549	1.7	12.0	57.3	27.4	96.7	2.8	0.5	0.0		
RZ - 6	1.8	6.7	68.3	5.6	80.6	19.4	0.0	0.0		
Hen - Sam	1.0	10.0	68.2	21.7	100.0	0.0	0.0	0.0		
LSD - 5%	ns	9.8	13.5	11.1	4.0	3.4	ns	1.0		

Table 5(d) Bulb description, soluble solids (SS) and storage data for the fourth planting.

Variety	Shells	TSS (brix %)	Shape	Skin Colour	Soundness %	Black* Mould %	Greening Rating**	Firmness	
								Harvest	12 Weeks
4.6.98									
Neu - Wab	2.1	6.4	4	Brown	70.0	47.6	1	Firm-hard	Firm
Grs - Glb	2.0	6.3	5	Brown	90.0	51.9	2	Firm-hard	Firm
Lef - Web	2.4	7.0	2-3	Brown	73.3	54.5	2.5	Firm-hard	Firm-hard
Lef - 1096	2.1	5.9	4	Lt Brown	90.0	25.9	2	Firm-hard	Firm-hard
Lef - 1097	2.1	7.2	2	Red	73.3	59.1	1	Firm	Firm
Lef - 1099	2.0	6.4	1-2	Brown	93.3	35.7	1	Firm-hard	Firm-hard
Lef - 1102	1.9	6.6	3-4	White	73.3	13.6	1	Hard	Firm
Lef - 1103	2.3	6.4	1	Lt Brown	93.3	25.0	1	Firm-hard	Firm
Lef - 1104	2.3	6.1	5-6	Lt Brown	90.0	25.9	1	Firm	Firm
Lef - 1105	2.2	6.6	1	Brown	83.3	36.0	1	Firm-hard	Firm-hard
Yat - Cen	2.8	10.0	1	Br-Dk Brown	93.3	82.1	1	Hard	Hard
Yat - Chr	2.4	7.8	3-4	Brown	83.3	64.0	1	Firm-hard	Firm-hard
Yat - Gla	2.5	8.9	4-5	Br-Dk Brown	76.7	73.9	1	Hard	Hard
Yat - E511	2.1	6.3	3-4	Lt Brown	60.0	44.4	1	Firm	Firm
Yat - E537	2.3	9.3	5,6	Brown	100.0	53.3	1	Hard	Firm-hard
Yat - E540	2.9	8.5	4	Br-Dk Brown	86.7	92.3	1	Hard	Firm-hard
Yat - E544	2.3	5.9	4-5	Lt Br-Brown	83.3	64.0	1	Firm	Firm
Yat - F550	2.0	6.0	4	Lt Brown	70.0	76.2	1	Firm-hard	Firm-hard
Yat - F555	3.1	8.9	3	Brown	53.3	68.8	1	Hard	Firm-hard
Yat - F556	2.7	9.5	3-4	Brown	83.3	88.0	2	Firm-hard	Firm-hard
Yat - F558	2.9	8.5	3,4,5	Br-Dk Brown	70.0	76.2	2	Hard	Firm-hard
Yat - Z549	2.1	5.6	3	Gld Br-Brown	23.3	85.7	1	Firm-hard	Soft-firm
RZ - 6	2.0	7.1	2	Red	33.3	0.0	1	Firm	Firm
Hen - Sam	2.2	7.0	3-4	Brown	76.7	43.5	1	Firm-hard	Firm-hard
LSD - 5%		1.2							

* Percentage calculated from number of sound bulbs.

** Greening scale: 1 - nil; 2 - very slight; 3 - slight; 4 - marked; 5 - pronounced.

7.0 Section 4 - 1998 Variety Trial Series

7.1. Introduction

All four planned plantings in the 1998 trial series were successfully completed. This report presents results of each of these plantings. Results will be presented in tables that will contain data on three major areas of assessment. These areas are (i) yield, (ii) percentage make-up of the various bulb categories per plot as well as number of centres per bulb at harvest and (iii) bulb description and soluble solids per bulb (brix %). This progress report is designed to allow seed companies to decide which plantings and which varieties they would like to consider for the planned trial series in 1999.

7.2. 1998 participants

Five commercial seed companies and four local seed growers contributed varieties for assessment. In addition, varieties developed at Gatton Research Station were also entered in various plantings. The seed companies were Yates Seeds, South Pacific Seeds, Lefroy Valley and Magnus Kahl Seeds. Local seed growers who participated were Tom Else, Reg Neuendorf and Elwyn Litzow.

7.3. Climatic data

The climatic data for 1998 are presented in Table 1 where certain components are compared with corresponding long-term averages.

Table 1 Average maximum and minimum monthly temperatures and monthly rainfall for 1998 as well as monthly daylength range for Gatton Research Station.

Month	Av max temp (^{0}C)		Av min temp (^{0}C)		Rainfall (mm)		Daylength (hrs)
	1998	Long-term	1998	Long-term	1998	Long-term	
January	31.7	29.8	20.1	18.2	52.8	111.9	14.1 - 13.7
February	33.3	30.5	20.1	18.9	100.8	100.4	13.7 - 13.1
March	33.5	28.4	17.3	16.5	4.4	77.1	13.1 - 12.2
April	27.1	25.9	15.5	14.5	60.9	52.1	12.2 - 11.4
May	23.8	22.4	11.7	9.6	84.0	47.7	11.4 - 10.8
June	21.6	22.6	8.7	7.3	20.3	43.2	10.8 - 10.6
July	19.9	20.4	8.4	6.3	36.7	40.2	10.6 - 10.9
August	21.6	21.5	10.0	6.4	43.8	27.8	10.9 - 11.6
September	24.3	24.8	13.0	9.1	88.4	36.1	11.6 - 12.4
October	28.8	27.9	13.4	12.6	19.0	65.3	12.4- -13.0
November	28.1	29.1	14.9	15.7	104.8	75.3	13.0 - 13.9
December	31.1	29.8	18.4	16.5	79.4	99.5	13.9- -14.1

7.4. Testing procedures

In each planting, 3 replicates or plots of each entry were established. Each plot consisted of a pair of single rows (used to determine yield) and a single guard row on either side. Plots were established on beds with 1.5m centres. Seed was planted using an air seeder to ensure accurate intra-row spacing. Plant stands were hand thinned to remove double and triple plants as a result of the air seeder occasionally planting 2 or 3 seeds per planting site. Plots were 10m long and yield was measured from 8m of each of the single rows leaving a buffer of 1m at each end of the plot. Varieties were harvested when 80-100% of the tops were down and allowed to dry in trays before mechanical grading. Several varieties were not harvested due to excessive numbers of seed stems (> 50%). These varieties are denoted by DNH in the yield data tables.

At harvest, the number of seed stems and bullnecks were counted. When grading, the number of doubles, purples and off-types (off-colours) were recorded as well as the numbers within the pickling, No. 1 and No. 1 large grades. These grades refer to bulb diameters with the pickling grade being 20-40mm, the No.1 grade 40-75mm and No. 1 grade being greater than 75mm.

7.5. Results

Yields expressed in t/ha of saleable onions (picklers, No. 1 grade and No. 1 grade large) as well as yields of reject bulbs (doubles, off-types and coloured) are presented in Tables 3(a) (planting 1), 3(b) (planting 2), 3(c) (planting 3) and 3(d) (planting 4). Similarly, the percentages of bulbs per plot falling into the various categories are presented in Tables 4(a), 4(b), 4(c) and 4(d), additionally number of centres per bulb and seed stem production are presented in Tables 4(a) (planting 1), 4(b) (planting 2), 4(c) (planting 3) and 4(d) (planting 4). Shape, colour, soluble solids (brix%), dry matter percentage and firmness details from the various plantings are presented in Tables 5(a) (planting 1), 5(b) (planting 2), 5(c) (planting 3) and 5(d) (planting 4).

7.6. General comments

Seasonal conditions

Weather conditions early in the season resulted in excellent growing conditions for the trials planted in March and April. The plants were vigorous and grew exceptionally well in both these plantings. A prolonged warm spell in early April resulted in high percentages of double bulbs from the March planting. May and June trial plantings established quite well and looked promising until ideal weather conditions for the spread of downy mildew and thrips occurred in late July through to early/mid August. Consequently yields were not as high as was initially expected from these plantings. Control of downy mildew and thrips is still a major issue for mid to late season onions.

Early Season Varieties (Planting 1 -19th March)

Whites

Only two whites cultivars were tested in this trial. Else's Early White (54.8 t/ha) outperformed Neuendorf's Early Lockyer White (46.0 t/ha). This strain also produced fewer doubles than the Neuendorf strain.

Browns

Yates's Cavalier (formerly E515)) was the outstanding cultivar in this planting with the highest yield (66.2 t/ha and lowest percentage of doubles (3.5 %). Golden Brown continues to perform quite well at this time of planting but market acceptability is a major problem for this variety. Poor skin quality and retention have resulted in a reduced acceptance of this variety.

Four new experimental lines were tested. None of these cultivars performed well. Two of the lines did not get harvested (Lefroy Valley's 875 and Magnus Kahl's 801). The remaining two varieties produced low yields and a high proportion of doubles (Lefroy Valley 890 – 38.2% and Magnus Kahl 856 – 28.3%).

The local strain Neuendorf's Early Lockyer Brown is still available but has gone out of favour due to the incidence of purpling in the bulbs. Yield (37.9 t/ha) was satisfactory but lower than the best of the Golden Brown strains (Else – 45.0 t/ha and Neuendorf – 45.0 t/ha).

Mid-Season Varieties (Planting 2 - 15th April; Planting – 6th May)

Whites

Both white cultivars tested in the second planting were local selections, Else Early White and Neuendorf Early Lockyer White. There is very little difference between the varieties with the Else strain (42.2 t/ha) outyielding the Neuendorf selection (37.6 t/ha). There was a decrease in the percentage of doubles from the first planting. There are no commercial white varieties available for mid April planting. In the past, commercial white cultivars that have been tested in mid April have generally not yielded well and have produced a large percentage of thicknecks.

Four white cultivars were entered in the third planting. Best yields were obtained from the Yates' hybrids 5083 (51.3 t/ha) and 5084 (52.0 t/ha). The cultivar Yates Cossack contained a large percentage of off-types (10.9%). This was primarily due to seed contamination with seed from a brown cultivar. The selection Yates 5082 produced bulbs that were inconsistent in shape varying from thick flat to high globe. The Gatton Research Station selection of Gladalan White produced a satisfactory yield with approximately 10% doubles.

Browns

A vast selection of browns was tested at both planting times. The local cultivars Golden Brown and Wallon Brown are the most popular varieties among growers for April and May plantings respectively. Commercial cultivars are starting to make large inroads into these planting times particularly from Yates.

The remainder of the varieties entered in the second planting were brown cultivars. Local strains still outperform most commercial cultivars in the second planting this includes Golden Brown and Early Lockyer Brown. The best of the Golden Brown strains was the Gatton Research Station selection although the differences between the three strains were not significant. Percentage of double in these selections was still higher than the commercial cultivars. The commercial cultivar Yates' Cavalier produced the highest marketable yield (66.2 t/ha) with the SPS selection 162 being the next best with a marketable yield of 47.6 t/ha. This hybrid produced a high percentage of seed heads (21.6 %). The Magnus Kahl Seeds' hybrid 111 yielded well but will struggle to be accepted on the fresh market due to its flat bulb shape. All varieties except MKS 111 and SPS 137and 162 satisfied the brix test for sweetness (>8 %) to be classified as a sweet onion. This is necessary if varieties are to be accepted for export into a sweet onion market.

A large number of brown cultivars were entered in the May planting. With the exception of Neuendorf's Wallon brown all cultivars were hybrids from commercial seed companies. Several varieties produced marketable yields in excess of 50 t/ha. This included the top two varieties Yates' F564 (57.2 t/ha) and Predator (56.3 t/ha). Other cultivars that performed well included South Pacific Seeds' 846 (now named Colombus), Yates' Cavalier and Z517 (now named Nautilus) and Gladalan Brown. The following varieties produced in excess of 40 t/ha South Pacific Seeds' 162 and Rio Xena and Yates' E538.The local cultivar Neuendorf's Wallon Brown did not perform as well as expected due to poor emergence. The experimental lines Lefroy Valley Seeds' 1367and 822, Magnus Kahl Seeds' 831 and Hazera's Arad produced unacceptably high percentages of doubles (10.8, 32.2, 13.1 and 15.6 % respectively). In general, brix % has increase in the third planting. Pungency levels also tend to increase in this planting resulting in a masking of the sweetness of the onion thereby making it unsuitable for the sweet onion market. The varieties South Pacific Seeds' Rio Xena and 846 and Magnus Kahl Seeds' 831 may have a low enough brix level to be acceptable on the mild sweet onion market.

Reds

The only red tested in mid season trials was entered in the third planting. This variety, South Pacific Seeds' Rio Demon, performed quite well and is a commercially available cultivar.

Late Season Varieties (Planting 4 – 3rd June)

Whites

No whites were entered in the fourth planting.

Browns

There were no local cultivars entered in the fourth planting. A number of varieties yielded in excess 50 t/ha (20 t/ac) including Yates' F550 (Terminator), E511 (Colossus) and A518 (Spartacus) and South Pacific Seeds' 846 (Columbus) and 1378. The highest yielding varieties were yates' F550 (Terminator) and South Pacific Seeds' 846 (Columbus) with total marketable yields of 56.8 t/ha and 53.8 t/ha respectively. The major component of these yields was No 1 Large bulbs. Yates' F550 produced 55.5 % No 1 Large bulbs and this component was 56.2 % of the total marketable yield for South Pacific Seeds' 846. A number

of varieties produce high percentages of double bulbs. The Lefroy Valley experimental line 689 produced in excess of 35 % double bulbs. The Yates variety A518 (Spartacus) yield in excess of 50 t/ha but also produced 7.7 t/ha (11.2%) of double bulbs. A number of other varieties produced in excess of 40 t/ha including South Pacific Seeds' Rio Xena (48.8 t/ha), Yates' E542 (40.7 t/ha) and Yates Predator (48.6 t/ha).

The varieties tested in this planting are predominantly high pungency types and therefore not suited to the mild sweet onion market. The only variety that meets the required criteria is South Pacific Seeds' Rio Xena. This variety performed well with an acceptable brix level of 7.6 %. This variety was bred specifically for the sweet onion market.

Reds

Only one red was entered in the fourth planting. This variety, South Pacific Seeds' Rio Demon, produced predominantly small bulbs with a high percentage of picklers (17.3%). Consequently, marketable yield was quite low.

LEGEND

GRS-ELB	Gatton Research Station -	Early Lockyer Brown (Barton Brown)
GRS-GoB	Gatton Research Station -	Golden Brown (Schroedon Brown)
GRS-GLB	Gatton Research Station -	Gladalan Brown (Wallon Brown)
GRS-GLw	Gatton Research Station -	Gladalan White (Wallon White)
ELS-GoB	Else -	Golden Brown
ELS-WH	Else -	White
NEU-ELW	Neuendorf -	Early Lockyer White
NEU-ELB	Neuendorf -	Early Lockyer Brown
NEU-GoB	Neuendorf -	Golden Brown
NEU-WAB	Neuendorf -	Wallon Brown
NEU-WAW	Neuendorf.-	Wallon White
LIT-GoB	Litzow -	Golden Brown
LIT-MuB	Litzow -	Mulga Brown
YAT-CAV	Yates Seeds-	Cavalier
YAT-CEN	Yates Seeds -	Centurion
YAT-COS	Yates Seeds -	Cossack
YAT-GLA	Yates Seeds -	Gladiator
YAT-PRE	Yates Seeds -	Predator
YAT-A518	Yates Seeds -	Experimental Line A518
YAT-E511	Yates Seeds -	Experimental Line E511
YAT-E515	Yates Seeds -	Experimental Line E515
YAT-E537	Yates Seeds -	Experimental Line E537
YAT-E538	Yates Seeds -	Experimental Line E538
YAT-E542	Yates Seeds -	Experimental Line E542
YAT-F550	Yates Seeds -	Experimental Line E550
YAT-F564	Yates Seeds -	Experimental Line F564
YAT-H5082	Yates Seeds -	Experimental Line H5082
YAT-H5083	Yates Seeds -	Experimental Line H5083
YAT-H5084	Yates Seeds -	Experimental Line H5084
YAT-Z517	Yates Seeds -	Experimental Line Z517
LEF-H686	Lefroy Valley East -	Experimental Line H686
LEF-H688	Lefroy Valley East -	Experimental Line H688
LEF-H689	Lefroy Valley East -	Experimental Line H689
LEF-H822	Lefroy Valley East -	Experimental Line H822
LEF-H875	Lefroy Valley East -	Experimental Line H875
LEF-H890	Lefroy Valley East -	Experimental Line H890
LEF-H1367	Lefroy Valley East -	Experimental Line H1367
ARAD	Lefroy Valley East -	Arad
MKS-111	Magnus Kahl Seeds -	Experimental Line - V50-3161111
MKS-801	Magnus Kahl Seeds -	Experimental Line - V50-3178801
MKS-831	Magnus Kahl Seeds -	Experimental Line - V50-3149831
MKS-856	Magnus Kahl Seeds -	Experimental Line - V50-3670856
MKS-DS	Magnus Kahl Seeds -	Experimental Line – Domenica Sweet
MKS-KS98	Magnus Kahl Seeds -	Experimental Line – KS98
SPS-137	South Pacific Seeds -	Experimental Line – 137-8
SPS-162	South Pacific Seeds -	Experimental Line – 162-8
SPS-846	South Pacific Seeds -	Experimental Line – 846
SPS-1348	South Pacific Seeds -	Experimental Line – 1348

SPS-DEM	South Pacific Seeds -	Experimental Line – Rio Demon
SPS-XENA	South Pacific Seeds -	Experimental Line – Rio Xena

Figure 1. Shape of Full Grown Bulbs

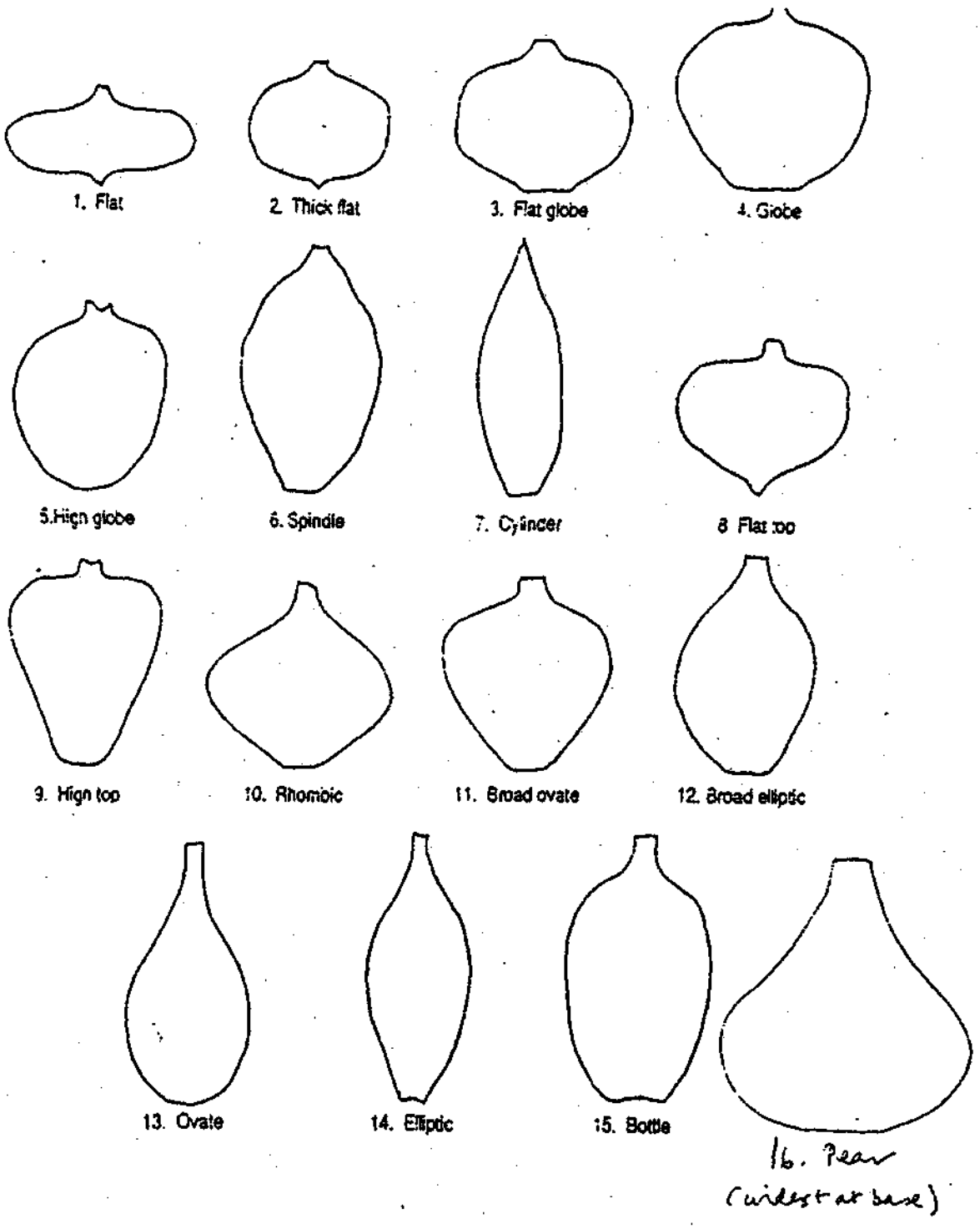

Table 3(a) Number of days to harvest and yield (t/ha) data for the first planting.

Variety	Days to Harves	SALEABLE				REJECTS		
		Pickler	No .1	No. 1 Large	Tot	Doubles	Off Types	Purple
19.3.98								
ELS-EW	168	0.5	12.5	41.8	54.8	7.8	0.4	0.0
ELS-GOB	168	0.3	7.3	37.4	45.0	20.0	0.4	0.0
GRS-ELB	168	0.1	1.1	23.3	24.4	6.8	1.0	1.2
GRS-GOB	168	0.4	8.0	30.2	38.6	23.1	0.1	0.0
LEF-875	DNH							
LEF-890	168	1.1	8.5	14.0	23.5	26.4	1.9	0.0
LIT-GOB	168	0.4	5.5	31.0	36.9	18.2	1.0	0.4
LIT-MUB	184	0.1	1.2	26.5	27.7	10.6	0.5	0.0
MKS-801	DNH							
MKS-856	184	1.5	9.1	14.5	25.2	17.4	0.0	0.0
NEU-ELB	168	0.1	3.3	34.6	37.9	5.9	0.7	5.8
NEU-ELW	168	0.4	5.3	40.3	46.0	13.5	1.0	0.0
NEU-GOB	168	0.5	9.7	34.8	45.0	14.4	0.7	0.8
YAT-CAV	184	0.6	8.3	57.3	66.2	2.5	0.0	0.0
LSD - 5%		0.5	1.3	6.8	7.5	5.0	ns	0.8

Table 4(a) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for the first planting.

Variety	Number of Centres	SALEABLE				REJECTS				
		Pickler	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
19.3.98										
ELS-EW	1.8	5.2	32.1	51.2	88.5	9.3	0.8	0.0	0.0	1.4
ELS-GOB	2.0	3.0	22.5	46.5	72.0	25.9	0.4	0.0	1.5	0.2
GRS-ELB	2.1	2.0	6.7	65.3	74.1	17.8	4.1	2.1	0.6	1.4
GRS-GOB	2.0	4.6	24.2	40.1	68.8	29.9	0.5	0.0	0.2	0.7
LEF-875	DNH									
LEF-890	2.0	8.4	22.0	18.4	48.8	38.2	4.1	0.0	7.4	1.5
LIT-GOB	1.8	3.9	19.4	47.4	70.7	25.2	1.8	0.4	0.9	1.0
LIT-MUB	2.6	1.2	8.0	60.3	69.5	25.9	1.7	0.0	0.0	2.9
MKS-801	DNH									
MKS-856	1.9	11.0	25.4	16.3	55.6	28.3	0.0	0.0	6.0	10.0
NEU-ELB	1.9	2.0	13.7	56.1	71.8	11.3	1.8	11.0	0.4	3.8
NEU-ELW	2.3	6.0	17.7	54.3	78.0	17.9	1.4	0.0	0.2	2.5
NEU-GOB	2.0	5.1	27.1	45.3	77.5	18.6	1.4	2.1	0.0	0.4
YAT-CAV	1.5	6.6	23.1	61.2	89.9	3.5	0.0	0.0	0.6	6.0
LSD 5%	0.3	4.4	7.1	7.5	8.1	7.6	2.2	1.2	1.5	3.4

Table 5(a) Bulb description, soluble solids (TSS), dry matter (%) and storage data for the first planting.

Variety	TSS (brix %)	Dry Matter %	Shape	Skin Colour	Firmness
19.3.98					
ELS-EW	11.1	10.2	3	White	Firm-hard
ELS-GOB	10.8	10.3	3-4	Gld Br	Firm
GRS-ELB	9.7	9.2	3	Brown	Firm-hard
GRS-GOB	12.1	10.6	3-4	Gld Br	Firm
LEF-875	DNH				
LEF-890	11.0	10.7	5-6	Brown	Firm-hard
LIT-GOB	11.0	10.5	3-4	Gld Br	Firm-hard
LIT-MUB	9.4	8.7	3	Gld Br-Br	Firm-hard
MKS-801	DNH				
MKS-856	9.7	9.6	5-6	Brown	Firm-hard
NEU-ELB	9.7	11.0	3	Br-Dk Br	Firm-hard
NEU-ELW	11.4	9.2	2-3	White	Firm-hard
NEU-GOB	11.6	11.1	4-5	Brown	Firm-hard
YAT-CAV	9.9	9.3	4-5	Brown	Firm-hard
LSD 5%	1.0	0.7			

Table 3(b) Number of days to harvest and yield (t/ha) data for the second planting .

Variety	Days to Harves	SALEABLE				REJECTS		
		Pickler	No .1	No. 1 Large	Tot	Doubles	Off Types	Purple
15.4.98								
ARAD	DNH							
ELS-EW	156	0.9	15.4	24.9	42.2	4.5	0.0	0.0
ELS-GOB	156	0.5	13.2	25.2	38.8	8.0	0.3	0.0
GRS-GOB	156	0.5	12.7	27.4	40.7	7.3	0.2	0.0
LEF-1367	DNH							
MKS-801	DNH							
MKS-111	175	0.6	15.8	19.1	35.6	3.9	0.0	0.0
NEU-ELB	156	0.3	6.4	25.4	32.1	3.0	1.8	4.2
NEU-ELW	156	0.8	9.2	27.6	37.6	4.8	1.0	0.0
NEU-GOB	156	0.6	13.4	21.6	35.6	5.0	0.5	0.7
SPS-137	175	0.9	10.0	36.7	47.6	1.3	0.0	0.0
SPS-162	175	0.5	6.2	23.4	30.2	4.2	0.0	0.0
YAT-CAV	175	0.4	12.8	49.8	62.9	1.1	0.2	0.0
LSD - 5%		ns	ns	5.5	6.7	2.3	0.5	1.3

Table 4(b) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for the second planting.

Variety	Numbe of Centre	SALEABLE				REJECTS				
		Pickler	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
15.4.98 ARAD	DNH									
ELS-EW	1.4	7.8	42.4	36.6	86.8	6.9	0.0	0.0	0.0	6.3
ELS-GOB	2.0	5.5	39.7	39.6	84.9	13.7	0.6	0.0	0.2	0.6
GRS-GOB	1.7	5.5	36.9	42.6	85.0	13.2	0.4	0.0	0.6	0.9
LEF-1367	DNH									
MKS-801	DNH									
MKS-111	1.5	6.9	45.3	30.8	83.0	7.3	0.0	0.0	1.2	8.5
NEU-ELB	1.5	4.0	22.4	45.1	71.5	5.6	3.5	11.8	0.5	7.2
NEU-ELW	1.5	8.9	29.4	46.7	84.9	8.3	1.7	0.0	0.3	4.9
NEU-GOB	2.1	6.6	42.3	37.5	86.4	8.8	1.1	1.8	0.5	1.4
SPS-137	1.4	7.2	32.2	53.6	93.0	2.3	0.0	0.0	0.0	4.7
SPS-162	1.1	6.4	23.6	41.0	71.0	7.1	0.0	0.0	0.2	21.6
YAT-CAV	1.3	4.1	17.1	71.4	92.6	1.5	0.2	0.0	0.7	5.0
LSD - 5%	0.6	ns	10.0	10.3	3.9	3.8	0.8	2.5	ns	2.6

Table 5(b) Bulb description, soluble solids (TSS), dry matter (%) and storage data for the second planting.

Variety	TSS (brix %)	Dry Matter %	Shape	Skin Colour	Firmness
15.4.98					
ARAD	DNH				
ELS-EW	9.1	8.3	3	White	Firm
ELS-GOB	8.9	8.5	3-4	Gld Br–Br	Firm-hard
GRS-GOB	8.9	8.0	3-4	Gld Br	Firm-hard
LEF-1367	DNH				
MKS-801	DNH				
MKS-111	6.8	7.4	1-2	Br-Dk Br	Firm
NEU-ELB	8.6	8.3	3	Br-Dk Br	Firm-hard
NEU-ELW	9.4	8.3	2-3	White	Firm-hard
NEU-GOB	9.0	8.8	3-4	Brown	Firm-hard
SPS-137	7.6	7.5	5	Brown	Firm
SPS-162	6.9	6.8	5	Brown	Firm
YAT-CAV	8.3	7.5	4-5	Gld Br- Br	Firm-hard
LSD - 5%	1.0	0.8			

Table 3(c) Number of days to harvest and yield (t/ha) data for the third planting .

Variety	Days to Harves	SALEABLE				REJECTS		
		Pickler	No .1	No. 1 Large	Tot	Doubles	Off Types	Purple
6.5.98								
ARAD	175	1.6	22.8	11.7	36.0	7.2	0.2	
GRS-GLB	154	0.6	8.7	43.1	52.3	5.3	0.0	
GRS-GLW	154	1.1	13.1	28.4	42.5	5.0	0.0	
LEF-1367	175	1.0	19.7	16.4	37.1	4.1	0.0	
LEF-822	175	1.9	9.0	5.7	16.6	8.8	0.8	
MKS-831	175	0.7	16.9	21.4	38.9	6.0	0.4	
MKS-DS	DNH							
NEU-WAB	154	0.4	5.2	23.0	28.6	3.4	0.0	
SPS-162	160	1.3	17.3	25.9	44.5	2.6	0.0	
SPS-846	154	0.7	6.3	44.8	51.7	2.4	0.0	
SPS-DEM	160	1.3	20.2	11.7	33.2	1.7	0.1	
SPS-XENA	160	0.8	10.3	30.1	41.2	2.0	0.6	
YAT-5082	160	0.7	21.0	21.8	43.5	2.8	0.2	
YAT-5083	154	0.5	13.0	37.8	51.3	1.5	0.1	
YAT-5084	154	0.3	11.7	40.1	52.0	1.5	0.0	
YAT-E537	188	2.0	20.3	10.3	32.7	2.8	0.0	
YAT-E538	154	0.8	12.4	35.8	48.9	2.4	0.0	
YAT-F564	154	0.2	8.1	48.9	57.2	1.0	0.0	
YAT-Z517	154	1.2	16.9	33.1	51.2	0.7	0.0	
YAT-CAV	154	0.7	11.9	39.7	52.2	0.6	0..0	
YAT-CEN	175	0.7	15.7	21.2	37.6	2.0	0.0	
YAT-COS	154	1.2	15.1	16.6	32.9	0.1	5.4	
YAT-PRE	154	0.4	8.7	47.2	56.3	1.3	0.0	
LSD - 5%		0.6	4.2	7.8	8.2	2.5	0.5	

Table 4(c) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for the third planting.

Variety	Number of Centres	SALEABLE				REJECTS				
		Picklers	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
6.5.98										
ARAD	1.7	13.1	54.6	16.4	84.1	15.6	0.4			
GRS-GLB	1.5	5.4	23.9	61.7	91.0	9.0	0.0			
GRS-GLW	1.3	8.2	36.6	45.8	90.6	9.4	0.0			
LEF-1367	1.1	8.2	53.0	28.1	89.2	10.8	0.0			
LEF-822	2.3	14.9	36.7	13.1	64.7	32.2	3.1			
MKS-831	1.1	5.3	44.7	36.0	86.0	13.1	0.9			
MKS-DS	DNH									
NEU-WAB	1.3	7.6	26.0	58.4	92.0	8.0	0.0			
SPS-162	1.1	9.9	44.7	38.8	93.4	6.6	0.0			
SPS-846	1.1	6.4	19.9	69.1	95.3	4.7	0.0			
SPS-DEM	1.3	11.9	62.0	21.6	95.5	4.2	0.4			
SPS-XENA	1.1	9.1	33.6	51.7	94.4	4.3	1.3			
YAT-5082	1.3	6.3	53.1	34.0	93.4	6.3	0.3			
YAT-5083	1.7	4.4	32.4	60.2	97.0	2.8	0.2			
YAT-5084	1.3	2.3	32.3	62.8	97.4	2.6	0.0			
YAT-E537	1.9	15.5	59.7	17.9	93.1	6.9	0.0			
YAT-E538	1.2	6.5	34.9	54.2	95.6	4.4	0.0			
YAT-F564	1.1	2.1	19.1	76.9	98.2	1.8	0.0			
YAT-Z517	1.1	9.1	44.6	45.2	98.9	1.1	0.0			
YAT-CAV	1.1	5.7	32.8	60.4	98.9	1.1	0.0			
YAT-CEN	1.9	7.5	48.7	39.0	95.2	4.8	0.0			
YAT-COS	1.7	9.5	47.1	32.4	88.9	0.2	10.9			
YAT-PRE	1.2	3.8	23.6	70.2	97.6	2.4	0.0			
LSD - 5%	0.4	4.0	9.2	10.2	5.0	5.2	0.9			

Table 5(c) Bulb description, soluble solids (TSS), dry matter (%) and storage data for the third planting.

Variety	TSS (brix %)	Dry Matter %	Shape	Skin Colour	Firmness
6.5.98					
ARAD	9.8	9.3	2-3	Brown	Hard
GRS-GLB	8.3	7.8	3-4	Brown	Firm-hard
GRS-GLW	9.7	8.2	3	White	Firm-hard
LEF-1367	9.0	8.1	3	Lt Br-B	Hard
LEF-822	10.6	9.6	3-4	Brown	Firm-hard
MKS-831	7.7	8.3	4-5	Lt Br	Firm-hard
MKS-DS	DNH				
NEU-WAB	7.8	7.6	3-4	Brown	Firm-hard
SPS-162	7.4	7.5	4	Lt Br-B	Firm-hard
SPS-846	8.4	7.4	4	Brown	Firm
SPS-DEM	10.1	9.8	3,4,5	Red	Firm-hard
SPS-XENA	7.4	7.0	3-4	Lt Br	Firm
YAT-5082	10.9	9.9	2,3,4,5	White	Firm-hard
YAT-5083	8.4	7.8	3-4	White	Firm-hard
YAT-5084	8.5	8.2	3	White	Firm-hard
YAT-E537	11.1	7.8	5	Brown	Hard
YAT-E538	8.7	8.5	4-5	Brown	Hard
YAT-F564	9.6	8.6	4-5	Brown	Firm-hard
YAT-Z517	7.9	7.9	3-4	Brown	Hard
YAT-CAV	9.1	8.3	3-4	Brown	Firm-hard
YAT-CEN	11.5	11.4	3-4	Brown	Hard
YAT-COS	9.9	9.3	4-5	White	Firm-hard
YAT-PRE	8.6	8.1	3-4	Brown	Hard
LSD - 5%	0.8	0.7			

Table 3(d) Number of days to harvest and yield (t/ha) data for the fourth planting .

Variety	Days to Harves	SALEABLE				REJECTS		
		Pickler	No .1	No. 1 Large	Tot	Doubles	Off Types	Purple
3.6.98								
ARAD	170	0.7	29.0	6.9	36.6	8.4		
LEF 686	184	2.4	23.3	4.7	30.3	4.7		
LEF 689	184	1.2	16.6	2.6	20.4	13.0		
MKS DOM	DNH							
MKS KS98	147	2.6	33.3	0.0	36.0	1.9		
SPS 1348	170	0.4	12.7	38.6	51.6	3.2		
SPS 846	147	0.4	14.3	39.1	53.8	2.0		
SPS DEM	147	2.3	27..3	0.0	29.6	0.3		
SPS XENA	147	0.7	23.0	25.0	48.8	0.5		
YAT A518	170	1.0	17.8	36.0	50.6	7.7		
YAT E511	170	0.7	15.9	35.3	52.6	3.2		
YAT E537	170	1.7	27.0	10.3	34.1	3.8		
YAT E542	184	0.9	29.5	31.8	40.7	3.1		
YAT F550	147	0.5	13.8	42.6	56.8	5.4		
YAT CEN	170	0.5	22.9	16.1	39.5	2.9		
YAT GLA	170	1.1	24.3	9.2	34.5	7.5		
YAT PRE	147	0.7	22.4	25.5	48.6	2.4		
LSD - 5%		0.8	6.2	5.7	4.4	2.2		

Table 4(d) Number of centres per bulb and percentage bulbs occurring in saleable and unsaleable categories for the fourth planting.

Variety	Number of Centres	SALEABLE				REJECTS				
		Picklers	No. 1	No.1 Large	Total	Doubles	Off Types	Purple	Bullneck	Seed Heads
3.6.98										
ARAD	1.2	5.7	66.7	10.3	82.7	16.8	0.4		0.0	
LEF 686	1.1	17.0	59.7	7.3	84.1	13.4	0.2		0.0	
LEF 689	1.3	9.7	47.3	4.7	61.7	35.9	0.0		0.2	
MKS DOM	DNH									
MKS KS98	1.6	15.6	79.0	0.0	94.6	5.4	0.0		0.0	
SPS 1348	1.3	3.9	31.8	57.8	93.5	5.6	0.0		0.2	
SPS 846	1.1	4.2	35.7	56.2	96.1	3.7	0.0		0.2	
SPS DEM	1.2	17.3	79.5	0.0	96.7	1.0	1.8		0.5	
SPS XENA	1.0	6.3	49.2	43.3	98.8	1.1	0.0		0.2	
YAT A518	1.1	7.6	40.5	40.5	88.6	11.2	0.0		0.2	
YAT E511	1.4	6.0	38.3	50.9	95.2	4.7	0.0		0.2	
YAT E537	1.5	10.0	70.0	8.4	88.4	7.8	0.0		3.8	
YAT E542	1.7	5.5	70.2	16.6	92.3	6.5	0.0		1.2	
YAT F550	1.3	3.8	31.2	55.5	90.6	9.1	0.3		0.0	
YAT CEN	1.4	5.3	61.3	27.7	94.3	5.7	0.0		0.0	
YAT GLA	1.5	8.0	61.4	15.1	84.5	15.5	0.0		0.0	
YAT PRE	1.2	5.8	51.7	37.7	95.1	4.7	0.0		0.2	
LSD - 5%	0.4	5.0	10.1	9.1	3.9	3.9	0.4		0.7	

Table 5(d) Bulb description, soluble solids (TSS), dry matter (%) and storage data for the fourth planting.

Variety	TSS (brix %)	Dry Matter %	Shape	Skin Colour	Firmness
3.6.98					
ARAD	9.7	9.2	2-3	Dk Brown	Hard
LEF 686	8.6	9.4	4	Br-Dk Br	Firm-hard
LEF 689	9.4	10.2	4	Br-Dk Br	Hard
MKS DOM	DNH				
MKS KS98	7.9	8.0	1-2	Brown	Firm
SPS 1348	9.1	8.0	3-4	Br-Dk Br	Firm-hard
SPS 846	7.7	6.9	4-5	Brown	Firm-hard
SPS DEM	9.6	9.2	3-4	Red	Firm-hard
SPS XENA	7.6	7.0	4	Brown	Hard
YAT A518	7.7	7.9	3-4	Brown	Firm-hard
YAT E511	8.7	7.8	4	Brown	Firm-hard
YAT E537	10.9	11.0	4-5	Br-Dk Br	Hard
YAT E542	9.0	10.4	4	Lt Br-Br	Firm-hard
YAT F550	8.1	7.4	3-4	Brown	Hard
YAT CEN	11.0	10.5	4	Br-Dk Br	Hard
YAT GLA	10.4	10.5	3-4	Br-Dk Br	Hard
YAT PRE	9.0	8.9	4	Lt Br-Br	Firm-hard
LSD - 5%	0.7	0.5			

8.0 Section 5 – Jumbo Onion Trials

8.1. 1996 Jumbo Evaluation

Introduction

The 1996 jumbo onion trial was successfully completed. The major objective of this trial was to determine the advantages and disadvantages of transplants over direct seeding for jumbo onion production. This progress report presents the findings of this trial. The results are presented in a table containing data on yield of the various sizes and doubles, percentage of seed stems and doubles, number of centres per bulb and soluble solids.

The trial design was a completely randomised balanced factorial with 2 replicates or plots for each entry. Each plot consisted of a pair of single rows (used to determine yield) and a single guard row on each side. Ten metre long plots were established on beds with 1.5m centres. Inter-row spacing was set at 380mm. Yield measurements were taken from 8m of each of the single rows leaving a buffer of 1m at each end of the plot.

The factors compared were variety, planting method and plant spacing (Table 1). Seed companies were asked to supply a jumbo onion variety and four companies were able to do so. The companies and their varieties are Yates' E515, South Pacific Seeds' 883, Magnus Kahl Seeds' 944 and Lefroy Valley East's RX 135. Two plant spacings, 150mm and 200mm, were chosen for comparison. The two methods of planting were (i) Direct seeding where the seed was sown at the rate of 1.5g per row to ensure that the desired plant spacings of 150mm and 200mm were achieved; (ii) Transplants - transplants were raised at a local nursery prior to planting and then hand planted into the individual plots at 150mm and 200mm spacings. The direct seeded plots were planted on the 29th March and then hand thinned on the 9th May. The seed for the transplants was sown on the 18th March. The transplants were planted out on the 30th April.

Table 1 Jumbo onion trial treatments.

Variety)	Spacing (mm)	Planting Method	Variety	Spacing (mm)	Planting Method)
Yates E515	150	Direct	Yates E515	150	Transplanted
SPS 883	150	Direct	SPS 883	150	Transplanted
MKS 974	150	Direct	MKS 974	150	Transplanted
Lef RX 135	150	Direct	Lef RX 135	150	Transplanted
Yates E515	200	Direct	Yates E515	200	Transplanted
SPS 883	200	Direct	SPS 883	200	Transplanted
MKS 974	200	Direct	MKS 974	200	Transplanted
Lef RX135	200	Direct	Lef RX 135	200	Transplanted

At harvest, the number of seed stems and bullnecks were counted. When grading, the number of doubles and off-types (off-colours) were recorded as well as the numbers within the following grade sizes 0-100mm, 100-125mm and 125-150mm.

During grading, 30 bulbs were randomly selected for assessment of storage (twenty bulbs), soluble solids (five bulbs) and number of centres (five bulbs). Soluble solids were determined using a Kruss Optronic digital refractometer with results in brix (%). The number of centres per bulb was determined by cutting each bulb in half and counting the number of centres in the bulb. Two weeks after harvest the bulbs were tested for firmness, colour and shape. After a further 8-12 weeks, the bulbs were assessed for the number of skins (broken, split and complete), soundness (incidence of breakdown), firmness, degree of greening (1 nil - 5 intense) and incidence of sooty mould (*Aspergillus niger*).

Results

The following results are presented in Table 2: yield (t/ha) of saleable onions (0-100mm, 100-125mm, 125-150mm and total saleable), yield (t/ha) and percentages of double bulbs, percentage seed heads, number of centres per bulb and soluble solids (brix %).

Table 2 Yield, seed head and doubles percentages, number of centres/bulb and soluble solids (brix %) data as affected by variety (V), spacing (S) and planting method (P).

	V1	V2	V3	V4	LSD	S1	S2	LSD	P1	P1	LSD
0-100mm (t/ha)	10.8	4.1	6.8	15.9	6.7*	12.9	5.8	6.5*	9.3	9.4	ns
100-125mm (t/ha)	38.5	24.8	14.8	15.2	11.5**	25.1	21.6	ns	23.6	23.1	ns
125-150mm (t/ha)	15.6	22.6	3.6	1.1	11.7**	6.4	15.0	8.3**	10.1	11.3	ns
Total Saleable Yield (t/ha)	64.9	51.5	25.2	32.2	11.1**	44.4	42.5	ns	43.0	43.8	ns
Yield of Doubles (t/ha)	23.6	23.9	46.3	1.9	11.5**	20.9	26.9	ns	23.1	24.7	ns
Seed Heads (%)	15.5	25.9	26.8	46.5	11.1**	35.9	21.4	7.9**	30.3	26.9	ns
Doubles (%)	21.4	21.1	46.9	3.3	9.3**	18.3	28.1	6.6*	20.9	25.5	ns
No. of Centres/Bulb	2.5	1.5	3.1	1.5	0.5**	2.0	2.2	ns	2.0	2.2	ns
Soluble Solids (brix %)	8.7	6.4	8.1	6.6	1.3**	7.7	7.3	ns	7.6	7.3	ns

V1 - Yates E515 (Yates)
V2 - south Pacific Seeds 883 (SPS)
V3 - Magnus Kahl Seeds 974 (MKS)
V4 - Lefroy valley East RX 135 (LEF)

S1 - 150mm
S2 - 200mm

P1 - Direct seeding
P2 - Transplanted

Major Outcomes

Effect of planting method

- no effect on any character measured in Table 2.

Effect of spacing

- greater yield of smaller grade onions (0-100mm) at closer spacing
- greater yield of large grade onions (125-150mm) at wider spacing
- no significant difference for yield of 100-125mm grade or total yield of saleable onions
- greater yield of jumbo onions (100-150mm) from wider spacing
- greater percentage of seed heads at closer spacing
- greater percentage of doubles at wider spacing
- no difference in yield of doubles between spacings
- number of centres per bulb and soluble solids not affected by spacing

Effect of Varieties

- all characters measured were affected by variety
- Yates followed by SPS produced most jumbo size onions
- MKS high proportion of doubles
- Yates marginal but other varieties had unacceptable level of seed heads
- unacceptable level of doubles in Yates, SPS and MKS
- none of the varieties could be classed as having single centres - a highly desirable character in jumbo onions

Interactions

Variety vs Spacing

- 100-125mm yield ($P < 0.01$): LEF yielded much higher at the wider spacing whereas the closer spacing favoured the other three varieties.

- total saleable yield ($P < 0.05$): varieties reacted differently to spacings. Yates and to lesser extent SPS not affected greatly by spacing but in MKS closer spacing superior and opposite effect in LEF

- % seed heads ($P < 0.05$): not a great deal of difference spacings for SPS and MKS but marked increase in seed heads in Yates and LEF at the narrower spacing.

General conclusion

Planting method and spacing had no significant effect on saleable yield. Wider spacing gave a slight advantage on yield of jumbo onions. None of the varieties evaluated were particularly suited to the planting date used as seed stems and doubles were prevalent.

8.2. 1997 Jumbo Evaluation

Introduction

The 1997 jumbo onion trials were successfully completed. The major objective of this trial was to investigate a number of varieties available as jumbo types at two different planting times. The early planting consisted of four open-pollinated varieties from local seed producers and the later planting consisted of hybrids from commercial seed companies. This progress report presents the findings of these trials. The results are presented in tables containing data on yield of the various sizes and doubles, percentage of seed stems and doubles, and number of centres per bulb.

Testing Procedures

The trial designs were completely randomised blocks with 3 replicates or plots for each entry. Each plot consisted of a pair of single rows (used to determine yield) and a single guard row on each side. Ten metre long plots were established on beds with 1.5m centres. Inter-row spacing was set at 380mm. Yield measurements were taken from 8m of each of the single rows leaving a buffer of 1m at each end of the plot. Both trials were planted using onion transplants. This ensured accurate spacing of plants. The early trial was transplanted on 31st March and the later trial was transplanted on 14th May. Plants were planted at 0.15m spacings. This spacing was based on results from the jumbo trial in 1996 where 0.15m spacing proved to be better than a spacing of 0.2m

At harvest, the number of seed stems and bullnecks were counted. When grading, the number of doubles and off-types (off-colours) were recorded as well as the numbers within the following grade sizes 0-100mm, 100-125mm and 125-150mm.

The number of centres per bulb was determined by cutting each bulb in half and counting the number of centres in the bulb.

Results

The results obtained from the first trial are presented in Table 1: yield (t/ha) of saleable onions (0-100mm, 100-125mm, 125-150mm and total saleable), yield (t/ha) and percentages of double bulbs, percentage seed heads and number of centres per bulb. Table 2 contains similar yield results for the later planted trial.

Table 1. Yield (t/ha), percentages of seed heads, off-colour and double bulbs, number of centres per bulb for the early season jumbo trial.

Varieties	Yield – t/ha (Bulb size in mm)				Bulbs - Percentage			Number of Centres per Bulb
	0-100	100-150	>150	>100	Seed Heads	Off-Colour	Doubles	
Early Lockyer White	33.8	0.2	0.0	0.2	1.3	4.3	0.0	1.8
Early Lockyer Brown	29.0	0.0	0.1	0.1	1.4	0.0	0.2	2.3
Golden Brown	36.9	0.0	0.0	0.0	0.5	0.6	3.0	2.5
Wallon Brown	43.3	4.1	0.0	4.1	0.4	0.0	6.4	2.0
LSD 5%	**5.1**	**2.7**	**ns**	**2.8**	**ns**	**1.8**	**2.6**	**ns**

Table 2. Yield (t/ha), percentages of off-colour and double bulbs, number of centres per bulb for the mid-late season jumbo trial.

Varieties	Yield – t/ha (Bulb size in mm)					Bulbs - Percentage		Number of Centres per Bulb
	0-75	75-100	100-150	>75	>100	Off-colour	Doubles	
Neu Wab	10.8	17.5	1.7	19.2	1.7	0.0	1.4	2.3
MKS 893	9.0	19.6	0.0	19.6	0.0	0.0	8.9	2.5
MKS 1348	9.4	18.3	5.2	23.5	5.2	0.0	1.1	2.3
Yat E511	3.8	35.2	12.7	47.9	12.7	0.7	0.7	1.9
Yat E540	16.3	0.9	0.0	0.9	0.0	0.0	7.1	2.2
Yat E544	8.2	30.8	0.7	31.5	0.7	0.0	0.4	1.9
Yat F550	9.0	28.7	2.1	30.7	2.1	1.0	1.1	1.9
Yat F555	13.7	16.0	0.0	16.0	0.0	0.0	2.4	2.0
Yat NW155	10.8	18.3	0.9	19.2	0.9	0.0	0.0	1.3
Yat Z549	7.4	24.5	1.6	26.1	1.6	0.4	6.2	2.6
LSD 5%	**5.1**	**9.1**	**2.8**	**10.3**	**2.8**	**ns**	**4.5**	**0.6**

Discussion

Early Season Trial

This trial consisted of only locally produced varieties, as they are more adapted to this planting time. None of the varieties tested produced a sufficient number of bulbs in the desired size range of 100-150mm to be considered as a contender for the jumbo onion market. Due to the wide plant spacing the overall yield for all four varieties was quite low particularly a general fresh market onion crop. The highest yielding variety was Wallon Brown with a yield of 43.3 t/ha. This variety also produced the highest percentage of doubles.

Mid-Late Season Trial

This trial consisted of predominantly hybrid onion varieties from the commercial seed companies with only one locally produced open-pollinated variety, Wallon Brown (ex Neuendorf). The commercial hybrids were supplied by Yates Seeds (7 varieties) and Magnus Kahl Seeds (2 varieties). Seven of the varieties produced bulbs in the jumbo onion size range (> 100mm). The yield of jumbo sized onions varied from 0.9 t/ha to 12.7 t/ha. The best performers were the Yates Seeds hybrid E511 (12.7 t/ha) and the Magnus Kahl Seeds strain MKS 1384 (5.2 t/ha). Neither of these varieties produced sufficient yield to be considered for the jumbo onion market. The variety E511 produced the largest percentage of its yield (35.2 t/ha – 68%) in the 75-100mm size range. Although the nine varieties tested were considered to be jumbo onion varieties it was disappointing that none of these varieties performed as such.

8.3. 1998 Jumbo Evaluation

Introduction

The 1998 jumbo trial was successfully completed. The object of this trial was to determine optimum times and rates for nitrogenous fertiliser applications for jumbo-sized onion production. The trial was planted in May when the majority of jumbo onions are planted in Queensland. A combination of two varieties (one hybrid and one open pollinated), three application rates and two timing regimes was examined. This progress report outlines the findings of this trial. Results are presented in tables containing data for yield of the various sizes and doubles.

Materials and Methods

The trial design was a completely randomised block with three replicates for each treatment. Each plot consisted of a pair of 10 metre single rows (datum) and a single guard row on each side of the datum. The four rows were planted on 1.2 metre beds with an inter-row spacing of 0.3 m. Spacing between plants within each row was 0.15 m. Yield measurements were based on an 8 metre by 2-row sample taken from within the datum area. The trial was direct seed using a Miniair air-seeder. Nitrogen was applied (broadcast) at 50, 100 and 150 t/ha of nitrogen as urea (46% N). Each application of nitrogen was split into either two or three equal applications. Applying the nitrogen in two equal quantities resulted in applying the nitrogen at the 4- and 7-leaf stage. Three times of application resulted in three equal quantities of nitrogen being applied at the 4-leaf, 7-leaf and 10-leaf stages. The two varieties used were Yates' Colossus and Gatton Research Station Gladalan Brown (Wallon Brown). The trial was planted on 6th May. Gladalan Brown was harvested on the 13th October and Colossus harvested four weeks later on the 10th November.

At harvest, plot yield was broken into the following grade sizes: 0-75mm, 75-100mm, 100-125mm and greater than 125mm. The required size for the jumbo market is greater than 100mm. The number of double bulbs produced was also recorded.

Results

The complete set of results is presented in Appendix 1. Results indicate that neither nitrogen rate nor frequency of application made an impact on the yield of jumbo-sized onions. The only significant yield differences recorded were between the varieties (See Table 1). Yates' Colossus produced significantly greater yields in the 75-100 mm grade and the 100-125 mm grade than Gladalan Brown. Gatton Research Station Gladalan Brown produced a significantly higher percentage of double bulbs than Yates' Colossus.

Table 1. Yield (t/ha) of the various grade sizes and percentage of double bulbs for the jumbo onions Yates Colossus and Gatton Research Station Gladalan Brown.

Variety	Yield - t/ha			Bulbs - %
	0-75mm	75-100mm	100-125mm (Jumbo)	Doubles
Colossus	10.03	26.67	13.44	3.96
Gladalan Brown	8.66	23.97	8.31	8.62
LSD – 5%	ns	2.16	2.10	2.13

Discussion

A comparison of different nitrogen rates and differing application times did not result in any significant yield differences in the production of jumbo onions for the two varieties tested.

The yield of jumbo size (greater than 100mm) onions from both varieties was low. Consequently, neither variety could be considered an economically viable proposition for the jumbo onion market.

Jumbo onions are a specialised market and the diameter of the onion is determined more by the genetics of the variety rather than nitrogen application rates or frequency.

APPENDIX 1

Main Effect – Nitrogen Rate

N-Rate	Yield – t/ha				Number of bulbs - Percentage			
	0-75mm	75-100mm	100-125mm	Doubles	0-75mm	75-100mm	100-125mm	Doubles
50	10.14	25.57	10.28	3.95	38.8	43.03	11.34	6.84
100	8.83	25.00	10.51	3.45	36.4	44.54	12.68	6.37
150	9.06	25.40	11.83	2.93	37.2	43.37	13.73	5.67

Main Effect - Frequency

Frequency	Yield – t/ha				Number of bulbs - Percentage			
	0-75mm	75-100mm	100-125mm	Doubles	0-75mm	75-100mm	100-125mm	Doubles
2	9.19	25.03	11.13	3.47	37.8	43.13	12.81	6.25
3	9.50	25.61	10.62	3.42	37.1	43.44	12.36	6.33

Main Effect - Variety

Variety	Yield – t/ha				Number of bulbs - Percentage			
	0-75mm	75-100mm	100-125mm	Doubles	0-75mm	75-100mm	100-125mm	Doubles
Colossus	10.03	26.67	13.44	2.77	37.4	43.86	14.73	3.96
Gladalan Brown	8.66	23.97	8.31	4.12	37.1	43.44	10.43	8.62

2-Way Interaction: N-Rate * Frequency

N Rate	Frequency	Yield – t/ha				Number of bulbs - Percentage			
		0-75mm	75-100mm	100-125mm	Doubles	0-75mm	75-100mm	100-125mm	Doubles
50	2	10.12	25.14	10.79	4.35	39.5	41.02	11.72	7.79
100	2	8.29	25.15	11.59	2.82	35.8	44.67	13.98	5.56
150	2	9.16	24.80	11.00	3.22	38.2	43.70	12.74	5.40
50	3	10.16	26.01	9.77	3.55	38.1	45.04	10.95	5.88
100	3	9.38	24.84	9.42	4.08	37.0	44.42	11.39	7.18
150	3	8.96	25.99	12.66	2.63	36.3	43.05	14.73	5.93

2-Way Interaction: N-Rate * Variety

Variety	N Rate	Yield – t/ha				Number of bulbs - Percentage			
		0-75mm	75-100mm	100-125mm	Doubles	0-75mm	75-100mm	100-125mm	Doubles
Colossus	50	10.45	26.77	12.98	3.74	36.6	43.66	14.21	5.52
	100	9.63	27.69	11.70	2.26	36.3	47.21	13.06	3.40
	150	10.00	25.56	15.64	2.31	39.4	40.71	16.93	2.96
Gladalan	50	9.83	24.38	7.58	4.16	41.0	42.40	8.46	8.15
Brown	100	8.04	22.30	9.32	4.64	36.5	41.88	12.31	9.34
	150	8.12	25.23	8.02	3.55	35.1	46.04	10.53	8.37

2-Way Interaction: Frequency * Variety

Variety	Frequency	Yield – t/ha				Number of bulbs - Percentage			
		0-75mm	75-100mm	100-125mm	Doubles	0-75mm	75-100mm	100-125mm	Doubles
Colossus	2	9.71	26.03	13.42	3.15	37.5	43.16	14.70	4.61
	3	10.34	27.32	13.46	2.39	37.4	44.56	14.77	3.32
Gladalan	2	8.67	24.03	8.84	3.78	38.1	43.10	10.93	7.89
Brown	3	8.66	23.91	7.77	4.45	36.9	43.77	9.94	9.34

3-Way Interaction: N-Rate * Frequency *Variety

Variety	N Rate	Frequency	Yield – t/ha				Number of bulbs - Percentage			
			0-75mm	75-100mm	100-125mm	Doubles	0-75mm	75-100mm	100-125mm	Doubles
Colossus	50	2	9.08	26.70	14.08	4.25	33.7	43.71	15.41	7.23
	100	2	9.63	26.90	12.81	2.19	37.3	45.38	14.41	2.95
	150	2	10.43	24.48	13.36	3.00	41.7	40.38	14.27	3.65
	50	3	11.82	26.84	11.88	3.23	39.6	43.61	13.02	3.82
	100	3	9.63	28.48	10.59	2.33	35.4	49.04	11.70	3.85
	150	3	9.56	26.64	17.92	1.61	37.1	41.03	19.59	2.28
Gladalan Brown	50	2	11.17	23.57	7.50	4.45	45.3	38.34	8.03	8.36
	100	2	6.95	23.4	10.37	3.45	34.3	43.96	13.54	8.16
	150	2	7.89	25.12	8.64	3.44	34.6	47.02	11.20	7.15
	50	3	8.5	25.18	7.66	3.87	36.7	46.46	8.89	7.94
	100	3	9.13	21.21	8.26	5.83	38.6	39.80	11.07	10.51
	150	3	8.35	25.34	7.40	3.66	35.5	45.06	9.86	9.59