

**DYNAMICS OF SEMI-ARID PLANT COMMUNITIES IN
WESTERN QUEENSLAND. 1. POPULATION SHIFTS OF
TWO INVADERS: CENCHRUS CILIARIS cv. GAYNDAH
AND HETEROPOGON CONTORTUS**

By J. K. CULL, Q.D.A., and J. P. EBERSOHN, M.Sc., Ph.D.

SUMMARY

Natural spread and aggregation of buffel grass (*Cenchrus ciliaris* cv. Gayndah) and of black or bunch spear grass (*Heteropogon contortus*) on a sandy levee of the Barcoo River in the Blackall district were measured.

Buffel grass was markedly better than black spear grass in colonizing areas previously unoccupied by either species. Over 5 years, buffel grass invaded and replaced low-density stands of black spear grass while it only partially invaded high-density stands.

I. INTRODUCTION

Black or bunch spear grass (*Heteropogon contortus* (L.) Beauv. invades some degraded communities and roadsides in western Queensland. Its seed in wool causes vegetable fault and increases processing costs. In addition, the seed pierces the skin and penetrates the flesh of sheep, resulting in irritation and loss of wool production in live sheep and downgrading of carcasses.

In western Queensland black spear grass is present over restricted areas, and is found principally on sandy loam soils. Such soils readily absorb rain and plants benefit from even light showers. This assists plants to endure drought.

Bisset (1962) expressed the opinion that black spear grass spreads in years with ample rainfall and is reduced during dry years. Martin (1962) and Purcell (1966) recommended that black spear grass should be actively replaced through cultivation and oversowing with buffel grass.

This study was undertaken to determine the degree to which buffel grass (*Cenchrus ciliaris* L. cv. Gayndah) will invade, colonize and replace black spear grass in one habitat in semi-arid western Queensland in which black spear grass readily invades.

II. METHOD AND MATERIALS

The exact date when buffel grass was first introduced into the study area is obscure but Humphreys (1967) credited S. L. Everist with introducing this species to Blackall in 1938.

In 1961 Gayndah buffel grass was observed to grow in association with black spear grass on the reasonably fertile sandy levees of the Barcoo River south of Blackall.

Both buffel grass and black spear grass formed distinct colonies, each consisting of a dense nucleus of older tussocks surrounded by more sparse younger plants as the distance from the nucleus increased. Other grasses occupying the interspaces included species of *Aristida*, *Chloris* and *Digitaria* and dense communities of *Bothriochloa ewartiana*. In this study quantitative estimates were not made of these species nor of the woody types, which are predominantly *Bauhinia hookeri*, *Acacia excelsa*, *Albizia basaltica*, *Geijera parviflora* and *Eremophila longifolia*.

During autumn each year for 6 years, frequency and density (5 years only) of buffel grass and black spear grass were obtained to use as an estimate of population shift in these two grasses.

Two sites, marked A and B and 200 yd apart, were selected where both buffel grass and black spear grass appeared to be well represented. The first measurements showed that at site A the two grasses were in approximately equal proportions while at site B buffel grass had already attained dominance.

From a central point at site A, 10 permanently fixed radiating lines each 80 lk long were located. Similarly, from site B seven fixed lines were located varying in length between 75 and 100 lk. Along each of the fixed lines, quadrats measuring 5 lk x 5 lk were placed immediately adjacent to each other on the same fixed positions each year.

The actual numbers of either species present in each fixed quadrat position were recorded except in 1966, when only the presence or absence of each species was recorded. The actual numbers present per quadrat provided data to give the mean density per quadrat over each site. The frequency figure is an expression of the presence or absence of each species over the range of quadrats counted.*

* *Frequency*.—The degree of uniformity with which individuals of a species are distributed in a stand.

Density.—The number of individuals in relation to the space in which they occur; refers to the closeness of individuals to one another.

Since rainfall is commonly regarded as the major variable influencing the seed set, establishment, aggregation and spread of plants in semi-arid areas, the annual precipitation for the period and the summer component of each season are given in Table 1.

TABLE 1
RAINFALL AT "DUNEIRA", BLACKALL (IN.)

Period	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	Annual Average (1911-1940)
October-March	16.18	18.43	31.07	10.37	6.89	11.85	13.63
Annual July-June ..	21.61	22.02	34.28	14.44	11.51	13.94	19.19

The rainfall is predominantly of summer incidence and is extremely variable in its annual amount. Average rainfall in the first two seasons was followed by well above average rainfall in 1962-63. The following summer was very dry. The 1964-65 year was a drought period which did not break until December 1966. The total rainfall for the previous 18 months was an all-time low of 11.67 in.

TABLE 2
FREQUENCY AND DENSITY OF BUFFEL GRASS AND BLACK SPEAR GRASS AT "DUNEIRA", BLACKALL

	Year					
	1961	1962	1963	1964	1965	1966
<i>Frequency/25 sq lk in permanent quadrats</i>						
Site A Buffel grass	0.46	0.53	0.72	0.75	0.76	0.84
Black spear grass	0.33	0.33	0.39	0.38	0.35	0.26
Site B Buffel grass	0.43	0.49	0.94	0.96	0.98	0.96
Black spear grass	0.17	0.18	0.33	0.37	0.32	0.06
<i>Density/25 sq lk in permanent quadrats</i>						
Site A Buffel grass	2.9	2.8	13.8	10.8	7.4	—
Black spear grass	3.3	3.0	3.5	3.1	2.3	—
Site B Buffel grass	2.6	2.5	13.7	9.0	7.6	—
Black spear grass	0.8	1.0	2.1	1.5	0.9	—

III. RESULTS

The frequency of buffel grass increased at first between 1962 and 1963, and thereafter remained more or less static (Table 2). Black spear grass remained stable at site A. At site B this species increased markedly during 1962-63, then remained stable in 1964 and 1965 and diminished sharply in 1966.

The density of buffel grass was similar at the two sites irrespective of season. It increased sharply in 1962-63 and diminished during the next 2 years. The number of plants per finite area in 1965 was about three times as many as in 1961. Black spear grass density at site A remained more or less stable. At site B an increase in this species occurred in 1962-63 but by 1965 the density had declined to its 1961 level.

Buffel grass, relative to black spear grass, had changed from an evenly dense species in 1961 to one three times as dense by 1965 (site A) and from a 3:1 ratio of species to one of 8:1 in favour of buffel grass at site B (Table 3).

TABLE 3

CHANGES IN DENSITY OF BUFFEL AND BLACK SPEAR GRASS IN FIXED 25 SQ LK QUADRATS BETWEEN 1961 AND 1965 AT "DUNEIRA", BLACKALL

SITE A								SITE B							
Line 1				Line 9				Line 1				Line 7			
1961		1965		1961		1965		1961		1965		1961		1965	
C.C.	H.C.	C.C.	H.C.	C.C.	H.C.	C.C.	H.C.	C.C.	H.C.	C.C.	H.C.	C.C.	H.C.	C.C.	H.C.
—	—	18	—	—	—	3	—	—	2	6	2	1	7	9	5
1	—	5	—	—	—	10	—	—	8	1	3	—	12	1	7
2	—	17	—	3	—	3	—	—	9	7	6	2	2	2	3
—	1	26	2	5	—	7	—	—	11	1	5	3	5	2	6
—	19	3	8	1	—	8	—	1	4	2	4	1	5	3	2
—	19	1	9	1	—	15	2	—	—	14	—	—	2	5	5
—	8	—	9	—	7	9	6	—	—	3	—	—	2	1	9
—	6	—	8	—	14	—	9	—	1	4	1	—	—	9	1
—	8	1	5	—	14	—	14	—	—	5	—	—	—	4	2

C.C. = Buffel grass

H.C. = Black spear grass

Buffel grass has strongly colonized those areas not previously occupied by either grass. Black spear grass has not moved into areas previously occupied by buffel grass. However, there has been a tendency for buffel grass to invade areas which in 1961 were dense stands of black spear grass.

At site A only partial invasion has taken place. At site B, where the black spear grass colonies were not as large, buffel grass had invaded every quadrat position by 1965. In 1966 it was observed that black spear grass remained in only one of the 18 quadrats. Buffel grass was present in every quadrat.

IV. DISCUSSION

When the sites were selected, equally frequent and dense populations of buffel grass and black spear grass were aimed at. This was more or less attained except at site B, where black spear grass was much less frequent and much less dense from the outset.

The October-March rainfall during the study period ranged from 6.89 to 31.07 in. This range could be regarded as a fair sample of rainfall conditions that can be expected to occur in semi-arid western Queensland. The rainfall for the 1962-63 summer was much more favourable for grass establishment than any other year.

The favourable 1962-63 season, with 31.07 in. of rain during the warm season, benefited buffel grass at both sites and black spear grass at site B only temporarily. The population potential of these two sites in terms of buffel grass appears identical but that of site B is much poorer for black spear grass. The greater number of new black spear grass plants at site B in 1963 suggests that many seedlings established following the rains but that most of these and also many mature plants died off when drought years followed. The stable population of black spear grass at site A suggests that very few seedlings became established in 1963 and that only mature plants survived the drought. Although buffel grass plants also suffered losses in the succeeding years, losses were nowhere as great as with black spear grass at site B. This suggests a greater drought tolerance of both buffel grass seedlings and adults. Old plants were retained as well as the new plants in freshly colonized areas.

Both species benefit from the wetter years and spread into adjacent native pasture. There is no evidence that black spear grass has established itself in areas dominated by buffel grass. Gayndah buffel grass is recognized as a slow colonizer when compared with other cultivars such as Biloela and American. These may be even more aggressive in invading pure stands of black spear grass.

A deficiency of the work has been the failure to also record frequency and density of other grass species and woody plants in the habitat.

While cultivation was not used on this area, it is considered that these results would apply to an area of black spear grass which is ploughed once and seeded to buffel grass. Seedlings of both species would establish to provide a mixed stand initially. The subsequent rate and degree of invasion and aggregation could depend on a number of factors, such as rainfall, soil fertility and whether buffel grass is permitted to seed. Once established, reinvasion of a dense sward of buffel grass by black spear grass is unlikely.

V. ACKNOWLEDGEMENTS

Financial support during the later stages of the investigation was obtained from the Australian Wool Board. The assistance of colleagues and of the owners of "Duneira", Blackall, is gratefully acknowledged.

REFERENCES

- BISSET, W. J. (1962).—The black spear grass (*Heteropogon contortus*) problem of the sheep country in central-western Queensland. *Qd J. Agric. Sci.* 19:189.
- HUMPHREYS, L. R. (1967).—Buffel grass (*Cenchrus ciliaris*) in Australia. *Trop. Grasslds* 1:121.
- MARTIN, A. G. (1962).—Buffel pushes out spear grass in plantings at Roma. *Qd Agric. J.* 88:136.
- PURCELL, D. L. (1966).—Black spear grass control in the central west. *Qd Agric. J.* 92:306.

(Received for publication June 7, 1968)

The authors are officers of the Agriculture Branch, Queensland Department of Primary Industries.