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Inter-plot Competition in Manurial Experiments Among different Genotypes of Sorghum

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The magnitude of border effect in sorghum manurial experiments and varietal cum manurial experiments were studied. In the manurial experiment with CSH 5 sorghum the grain yield of first border row of an experimental plot without nitrogen was 33.8 per cent higher than the remaining rows when the adjacent plot received 100 kg N/ha. But in plots with 100 kg/ha adjacent to plots without nitrogen the grain yield of first border row was 35.0 per cent lower than the remaining rows. Different genotypes of sorghum under different nitrogen levels revealed that the border effect was significant on the first border row when the experimental plot of tall COH 2 was adjacent to medium CSH 5 or dwarf CSV 4. Though the yield difference of rows was not present, the entire plot yield of CSV 4 was significantly lower when the adjacent plot was grown with tall COH 2 than medium CSH 5.

Inter-plot competition effects are known to exist in field experiments and are commonly known as border effects or alley effects and can be recognised readily by the differences in growth pattern and/or yields of the plants near the perimeter of the plot and in the central portion of the plot. Border effect can arise as a result of competition by the plants for moisture, light, nutrients, and the genotypes, adjacent to them.

The border effects, apart from the introduction of bias in the comparison of treatments, would lead to an inflation of error variance by increasing the heterogeneity among plots (Federer, 1974). The elimination of border effect is accomplished by leaving a non-experimental margin of pre-determined magnitude, the size of which usually vary with kind of crop plants grown or treatments given.

The importance of border effect in sorghum was felt by many workers like Cole (1926), Klages (1928) and Rangaswamy Ayyangar *et al.* (1939), Ross(1958), Miller and Colleir(1966)and Kern and Atkins (1970) but very little work has been done in India. Hence, with a view to determine the manitude of border effect in sorghum, manurial experiments and varietal cum manurial experiments, field experiments were conducted and the results obtained are presented in this paper.

MATERIALS AND METHODS

In *kharif* season of 1974 an experiment was laid out at the Tamil Nadu Agricultural University, Coimbatore,

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with CSH 5 sorghum under two levels of Nitrogen 0 and 100 kg/ha in the experimental plots and 0, 50, 100 kg/ha in the adjacent plots, i.e., plots surrounding all the sides of the experimental plots. The experimental plot consisted of 12 rows adopting a spacing of 45 cm x 15 cm. After eliminating six plants on both the ends of each row to avoid border effect on edge plants, centre eight plants were harvested in each row. Grain and straw yields were recorded separately. In the *kharif* 1975 season, in addition to the manurial treatments the experiment was conducted with 3 sorghum genotypes (dwarf CSV 4, medium CSH 5 and tall COH 2). During this year seven plants were left at either end of each row, centre 12 plants were harvested for comparing grain and straw yield of the rows in each plot. Statistical analysis was carried out separately for each season and for each set of treatment combination.

RESULTS AND DISCUSSION

The results of statistical analysis of *kharif* 1974 experiment on grain and straw yield of different rows of CSH 5 sorghum under different nitrogen levels are furnished in Table I. The results revealed that there was no border effect on the yield of outer rows when experimental plot received no nitrogen and the adjacent plots received either 0 or 50 kg N/ha. The different row yields in plots which received 100 kg/ha adjacent to the plots with the same level of nitrogen did not show any significant border effect. But in the case of experimental plots without nitrogen and the adjacent plot with 100 kg N/ha, the first border row of the experimental plot yielded significantly higher grain yield (33.8 per cent) than the remaining rows. But in the case of experimental plot which received 100 kg N/ha, the first border row of the plot gave 35.0 per cent lower yield than the other rows, when the adjacent plot was not manured. The mean hectare yield calculated from all the 12 rows was found to be 256 kg higher in the case of experimental plots without nitrogen and 384 kg lower in the case of experimental plots treated with 100 kg N/ha due to the border effect.

In the case of straw yield, only in the experimental plots receiving 100 kg N/ha, adjacent to plots with no nitrogen the first border row was significantly lower than the other rows (18.9 per cent). Drapala and Johnson (1961) found that there was border effect upto a distance of 38 cm in the case of Gahi millet and green leaf Sudan grass when 0 to 100 kg N/ha were applied to alternate plots in a block. In the present study the border effect was felt in the experimental plots with 0 and 100 kg N/ha when the adjacent plots received 100 and 0 kg N/ha respectively, upto only one border row of the experimental plot.

The results of the experiments conducted during the year 1975 are given in Table IIa & b. There was no significant difference in grain yield between the different rows in CSV4 variety grown either with 100 kg N/ha or without nitrogen and adjacent plots with CSH 5 and COH 2 with 0 and 100 kg N/ha. But the entire plot yield of CSV 4 was

TABLE I. Grain and straw yield of rows of CSH 5

Nitrogen level (kg/ha)		Mean grain and straw yield of rows in grams (from 1st outmost row to central row)										S.E. of mean		C.D. (P= 0.05)	
Experimental plot	Adjacent plot	Row 1		Row 2		Row 3		Row 4		Centre row					
		G.	St	G.	St.	G.	St.	G.	St.	G.	St.	G.	St.	G.	St.
0	0	348.5	628	372.8	613	432.1	790	341.1	682	394.5	707	32.0	52.0	N.S.	N.S.
0	50	373.3	700	336.4	747	342.3	561	407.0	757	333.0	552	33.8	45.2	N.S.	130.9
0	100	376.9	597	259.8	713	249.0	519	275.3	588	343.0	627	27.2	44.5	78.7	N.S.
100	0	227.1	509	312.1	617	380.3	676	345.1	607	359.5	610	28.4	32.9	82.0	95.3
100	50	358.9	620	367.4	630	269.1	618	321.8	507	366.5	629	24.2	49.5	69.9	N.S.
100	100	291.9	568	348.0	638	387.8	714	327.0	583	393.5	569	33.3	61.9	N.S.	N.S.

N.S. = Not significant, G = Grain St = Straw

TABLE II(a). Grain yield of rows in grams

Treatments: Experimental plot	Adjacent plot	Mean row yield of variety in the experimental plot when surrounded by varieties shown below		S.E. of mean	C.D. P = 0.05	Mean grain yield of rows in grams (from 1st outer most row to central row) Row 1	Row 2	Row 3	Row 4	Centre row	S.E. of mean	C.D. P= 0.05
:SV 4	CSH 5 or COH 2	CSH 5	COH 2	19.7	57.1	330	409	411	407	391	31.1	N.S.
) kg N/ha	100 kg N/ha	430	349									
CSV 4	CSH 5 or COH 2	CSH 5	COH 2	19.8	57.6	301	375	411	448	380	31.4	91.2
100kg N/ha	0 kg/ha	424	341									
CSH 5	CSV 4 or COH 2	CSV 4	COH 2	33.6	97.5	505	523	534	469	497	53.1	N.S.
0 kg N/ha	100 kg N/ha	576	435									
CSH 5	CSV 4 or COH 2	CSV 4	COH 2	10.9	31.6	481	462	522	464	429	54.4	N.S.
100kg N/ha	0 kg/ha	535	408									
COH 2	CSV 4 or CSH 5	CSV 4	CSH 5	22.3	N.S	975	730	652	653	585	35.2	102.2
0 kg N/ha	100 kg N/ha	731	709									
COH 2	CSV 4 or CSH 5	CSV 4	CSH 5	31.8	N.S.	818	704	706	613	593	50.3	145.9
100Kg N/ha	0 kg/ha	689	684									

N.S. = Not significant

significantly lower when the adjacent plot was grown with tall COH 2 than with medium CSH 5 variety either with or without nitrogen. Similarly, there was no significant difference in the yield of border rows in the experimental plots with CSH 5, but the plot yield was lower when the adjacent plot was grown with tall COH 2 than when the adjacent plot was grown with dwarf CSV 4. It would be probable that the entire experimental plot yield was affected due to the varying plant stature in the adjacent plots. As the three varieties CSV 4, CSH 5 and COH 2 recorded a mean plant height of 110.0 cm, 158.2 cm and 221.5 cm respectively it is probable that the shade effect of tall COH 2 variety sorrounding the CSV 4 experimental plot has affected the yield of CSV 4 more than in CSH 5. Similar results on varietal effect on borders have been reported by Miller and Collier (1966) and Kern and Atkins (1970) in sorghum.

In the experimental plots with COH 2, the grain yield of first border row was significantly higher than the centre row, when the adjacent plot was grown with either dwarf CSV 4 or medium tall CSH 5. The first border row yielded 67 per cent higher than the remaining rows in the plots without nitrogen while it was 38 per cent in the plots applied with 100 kg of N/ha. When the hectare yield was determined from all the 12 rows of the experimental plots

with 0 kg N/ha and 100 kg N/ha it was 514 kg and 373 kg respectively more than that of the yield estimated from only 10 middle rows after rejecting one border row on either side of a plot. This emphasises clearly the over-estimation of hectare yield if the first border row was not excluded from the experimental plot (Cole, 1926).

The straw yield between different rows did not show any significant difference except in the case of COH 2 grown without nitrogen in the experimental plot and adjacent plots with either CSV 4 or CSH 5 with 100 kg N/ha. The straw yield of first border row was 32.9 per cent higher than the centre row. In the case of COH 2 with 100 kg N/ha the first border row significantly yielded 21.1 per cent higher straw yield than the centre row.

In conclusion, the border effect on the first border row in CSH 5 sorghum was felt markedly when the experimental plot without nitrogen was adjacent to a plot with 100 kg N/ha or *vice versa*. The border effect on the first borderow of tall COH 2 sorghum experimental crop was marked when the experimental plot adjacent to either dwarf statured CSV 4 or medium statured CSH 5 variety. These results emphasise the need for rejection of one border row on either side of the experimental plots in manurial and varietal cum manurial experiments in sorghum. It requires detailed studies in larger areas since the entire plot yield of a

TABLE II (b). Straw yield of rows in grams

Treatments		Mean row yield of variety in the experimental plot when surrounded by varities shown below		S.E. of mean	C.D. (P = 0.05)	Mean straw yield of rows in grams (from1st outer most row to central row)						
Experimental plot	Adjacent plot					Row 1	Row 2	Row 3	Row 4	Centre row	S.E. of mean	C.D. (P = 0.05)
CSV 4 0 kg N/ha	CSH 5 or COH 2 100 kg N/ha	CSH 5 1127	COH 2 991	55	N.S.	997	1093	1053	1104	1047	87	N.S.
CSV 4 100 kg N/ha	CSH 5 or COH 2 0 kg N/ha	CSH 5 1294	COH 2 996	57	165	997	1129	1235	1196	1170	20	N.S.
CSH 5 0 kg N/hy	CSV 4 or COH 2 100 kg N/ha	CSV 4 1382	COH 2 1134	82	237	1245	1259	1318	1286	1182	129	N.S.
CSH 5 100 kg N/ha	CSV 4 or COH 2 0 kg N/ha	CSV 4 1239	COH 2 1003	58	161	1053	1077	1160	1189	1026	91	N.S.
COH 2 0 kg N/ha	CSV 4 or CSH 5 100 kg N/ha	CSV 4 2368	CSH 5 2199	88	N.S.	2787	2303	2138	2090	2097	139	403
COH 2 100 kg N/ha	CSV 4 or CSH 4 0 kg N/ha	CSV 4 2144	CSH 5 2000	94	N.S.	2269	2042	2239	1237	1874	148	N.S.

N.S. = Not significant

dwarf CSV 4 was lowered by the surrounding tall COH 2 than the medium CSH 5 and the row differences in CSV 4 could not be distinguished.

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