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RESPONSE OF SOLE AND INTERCROPPED MAIZE TO IRRIGATION AND NITROGEN LEVELS

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ABSTRACT

Experiments were conducted at the Tamil Nadu Agricultural University, Coimbatore for four consecutive seasons during 1989 *kharif* to 1990 *kharif* to elucidate the response of nitrogen and irrigation levels under sole and intercropped maize *Zea mays* L. The first set of experiment showed a linear response of yield with an increase in nitrogen levels. The second set of experiment clearly revealed that the crop responded upto 187.5 kg N ha^{-1} in both sole and intercropped situations. The intercrop did not cause either competitive depression or nitrogen transfer any level of irrigation or nitrogen. Irrigation at an IW/CPE ratio of 0.75 significantly increased the growth and yield of maize at all the levels of nitrogen and systems of cropping.

KEY WORDS : Maize, Response, Irrigation, Nitrogen Levels

Maize (*Zea mays L.*) crop is gaining ground in many parts of Tamil Nadu as an integral component of the integrated farming systems apart from its nature as a crop for food and industrial purposes. Adequate supply of water and nitrogen are the prerequisites for increasing the production of this crop. Response of maize to soil moisture is strongly dependent on nitrogen (N) levels of the soil (Black, 1966). Generally crops subjected to low levels of the soil N have lower growth rate and may affect the balance between the transpiration, nutrient uptake and water absorption. N deficiencies can alter the physiological responses of crop to water deficits (Jones *et al.*, 1986) and may result in plant characteristics often associated with drought resistance. Bennett *et al.* (1986) suggested that N deficient maize leaves were more sensitive to moisture deficits than leaves from N sufficient plants. Usually maize is planted in widely spaced rows and an intercrop can effectively utilise the environmental resources in a better way than sole cropping. It may also reduce the leaching losses of nutrients like nitrate nitrogen (NO_3-N) under irrigated condition (Singh *et al.*, 1978). Beneficial effects of intercropping of soybean with maize have been well documented by many workers (Patra and Chatterjee, 1986). Most of the intercropping studies were conducted either on rainfed or on constant irrigation level. Hence, it was felt imperative to study the response of N under varying moisture regimes in a cereal-legume intercropping system like maize-soybean.

MATERIALS AND METHODS

Field experiments were conducted for four consecutive seasons from 1989 *kharif* to 1990 *kharif* at the Tamil Nadu Agricultural University, Coimbatore. The experimental field was well drained, sandy clay loam in texture with a bulk density of 1.26 g/cm^3. The field capacity and permanent wilting point of the soil were 25 and 12 per cent respectively while pH and EC remained at 7.90 and 0.62 dSm^{-1}. The soil was low in available nitrogen (128.5kg ha^{-1}, medium in available phosphorus (15 kg ha^{-1}) and high in available potassium (382.5 kg ha^{-1}).

Experiment I was conducted during *khariff* and *rabi* seasons 1989-'90 comprised two levels of irrigation (IW/CPE ratio of 0.5 (I_1) and 0.75 (I_2) and four systems of cropping *viz.*, normal equidistance showing of maize at 60 x 20 cm (S_0), paired row sowing of (45 + 45) x 20 cm of maize (S_1) paired row of maize + one row of soybean (S_2) and paired row of maize + two rows of soybean (S_3) in main plots and three levels of N (93.75, 125 and 156.25 kg ha^{-1}) in sub plots tested in a split plot design with three replications. Since the paired and normal equidistance sown maize were on a par with each other and an increase in nitrogen levels showed a linear response to grain yield, slight modification were made in treatments of experiment II conducted in summer and *kharif* 1990. The normal equidistance sowing was deleted from the main plots and four levels (62.5 (N_1, 125 (N_2), 187.5(N_3) and 250 (N_4) kg ha^{-1}) were tested able 1. **Effect of irrigation, systems of cropping and nitrogen on the yield contributing characters of maize**

Treatment	Summer 1990							*Kharif* 1990						
	Barrenness (%)	Lodging (%)	Cob length (cm)	Cob width (cm)	No. of grains Cob^{-1}	Hundred weed weight (g)	Shelling (%)	Barrenness (%)	Lodging (%)	Cob length (cm)	Cob width (cm)	No. of grains Cob^{-1}	Hundred weed weight (g)	Shelling (%)
rrigation levels														
I_1	17.81	19.53	12.83	3.94	216	21.84	29.36	17.08	19.04	15.51	4.40	237	23.04	58.00
I_2	16.03	18.11	13.94	4.24	239	23.21	59.34	14.26	18.96	16.00	4.57	254	24.49	59.37
SED	0.05	0.15	0.07	0.04	1.61	0.09	0.19	0.13	0.18	0.66	0.05	0.83	0.07	0.07
CD (0.05)	0.12	0.32	0.15	0.09	3.59	0.21	NS	0.30	0.41	0.15	0.11	1.35	0.16	NS
System of cropping														
S_1	16.86	18.52	13.30	4.05	226	22.41	59.52	15.70	19.28	15.59	4.47	242	23.73	58.70
S_2	16.98	18.91	13.35	4.12	228	22.56	59.29	15.57	18.76	15.66	4.48	248	23.69	58.08
S_3	16.91	19.03	13.52	4.11	229	22.60	59.28	15.74	18.95	16.01	4.51	246	23.88	55.05
SED	0.07	0.19	0.08	0.05	1.97	0.12	0.24	0.16	0.22	0.08	0.05	1.01	0.06	0.07
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.18	NS	NS	NS	NS
Nitrogen levels														
N_1	20.27	20.07	12.32	3.73	200	21.00	57.59	18.92	17.42	13.92	4.23	193	21.07	56.49
N_2	17.07	19.36	13.27	405	219	22.00	59.47	15.19	18.24	14.90	4.40	241	23.52	58.95
N_3	15.13	18.03	14.09	4.31	246	23.51	60.38	13.79	19.22	17.17	4.67	274	24.76	59.69
N_4	10.20	17.83	13.97	4.27	247	23.47	59.99	13.78	21.11	17.02	4.64	273	24.80	59.60
SED	0.10	0.24	0.11	0.06	2.32	0.11	0.26	0.14	0.19	0.06	0.06	1.46	0.13	0.10
CD (0.05)	0.20	0.49	0.22	0.10	4.70	0.22	0.52	0.28	0.39	0.12	0.11	2.97	0.26	0.20

in sub plots. The other treatments remained unchanged in both the experiments.

RESULTS AND DISCUSSION

The increase in irrigation level from an IW/CPE ratio of 0.50 to 0.75 (I_1 to I_2) significantly increased the grain and stover yield in both the experiments. The grain and stover yield increased to a tune of 13.26 and 8.89 per cent in the first set of experiment in I_2 level of irrigation over I_1 (Tables 2, 3). The yield components *viz.*, cob length, cob width, number of grains per cob and test grain weight were appreciably increased in I_2 (Table 1). The lodging and barrenness of the crop was also reduced to the tune of 4.1 and 15.2 per cent in higher level of irrigation (I_2). Yield reduction due to water deficit occurred mainly through a reduction in number of grains per cob and individual grain weight. Logically a reduction in grain weight was due to a reduction in net photosynthesis and reduced translocation of dry matter of stalks to grain and accelerated leaf senescene. A drastic reduction in grain yield due to moisture stress was well established in maize (Harold, 1984; Narang *et al.*, 1989). Irrigation levels did not show any interaction effect with systems of cropping during the first and second set of experiments. Hence, it could be inferred that the intercrop did not increase the irrigation requirement of the main crop but with the same quantity of water an additional soybean crop could be raised without causing any detrimental effect to the maize crop. Similar saving of water through intercropping was obtained by Varughese *et al.* (1986) and Chaker and Kumar (1988). Seasonal consumptive use of water was more in higher level of irrigation and N. Similarly the soybean intercropped plots also recorded a higher seasonal consumptive use than sole crop of maize (Tables 2, 3).

Systems of cropping did not exhibit any marked differences in grain or stover yield of maize in all the experiments. In the first set of experiments, normal equidistance sown maize also registered comparable grain and stover yield with other systems of cropping. The results thus indicated that neither competitive depression for different growth factors nor N transfer from soybean occurred at any level of irrigation or N. In general, the lack of interaction between intercropping and added N indicated that there was

Table 2. The grain and stover yield of maize (kg ha^{-1}) and the seasonal consumptive use (mm) as influenced by irrigation, systems of cropping and nitrogen in the first set of experiment

Treatments	*Kharif* 1989			*Rabi* 1989-90			Pooled mean	
	Grain	Stover	Seasonal consumptive use*	Grain	Stover	Seasonal consumptive use*	Grain	Stover
Irrigation								
I_1	4089	6214	318.3	4551	6708	326.8	4320	6461
I_2	4609	6755	369.9	5177	7317	374.5	4893	7036
SEd	81.3	61.4		24.2	49.6		72.1	68.2
CD (P=0.05)	174.5	131.8		52.1	106.3		161.4	152.7
System of cropping								
S_0	4193	6442	330.0	4849	6979	341.8	4521	6711
S_1	4328	6583	336.3	4870	6984	347.3	4599	6784
S_2	4349	6359	348.0	4890	7005	354.5	4620	6682
S_3	4520	6552	362.2	4854	7078	362.5	4687	6815
SEd	115	86.9		34.3	70.2		120.2	98.5
CD (P=0.05)	246.8	NS		NS	NS		NS	NS
Nitrogen levels								
N_1	3672	5563	327.8	4271	6313	336.7	3972	5938
N_2	4365	6542	345.4	4813	6943	351.5	4589	6743
N_3	5005	7349	359.2	5510	7776	366.4	5258	7563
SEd	73.3	57.9		26.3	24.4		62.1	68.2
Cd (P=0.05)	150.0	117.7		53.6	50.2		126.4	138.9

* Data not analysed statistically

Table 3. The grain and stover yield of maize (kg ha^{-1}) and the seasonal consumptive use (mm) as influenced by irrigation, systems of cropping and nitrogen in the second set of experiment

Treatments	Summer 1990			*Kharif* 1990			Pooled mean	
	Grain	Stover	Seasonal consumptive use*	Grain	Stover	Seasonal consumptive use*	Grain	Stover
Irrigation								
I_1	3992	4901	325.3	3883	5755	328.9	3564	5328
I_2	3766	5703	371.7	4505	6958	394.6	4136	6331
SEd	21.4	37.3		11.2	14.2		8.5	11.5
CD (P=0.05)	47.9	83.3		25.5	31.8		19.3	25.9
System of cropping								
S_1	3505	5266	340.0	4177	6380	353.9	3841	5823
S_2	3547	5323	348.6	4172	6349	363.5	3854	5836
S_3	3537	5318	356.8	4162	6339	368.1	3851	5829
SEd	26.2	45.6		14.0	17.3		10.5	14.8
CD (P=0.05)	NS	NS		NS	NS		NS	NS
Nitrogen levels								
N_1	2755	4050	291.6	3104	4348	322.5	2390	4190
N_2	3490	5208	355.8	4141	6295	357.8	3815	5750
N_3	3932	5947	375.3	4729	7390	383.6	4331	6668
N_4	3943	6016	371.3	4708	7388	383.1	4324	6701
SEd	18.3	29.9		15.9	26.8		8.6	18.2
CD (P=0.05)	36.9	60.4		32.3	54.2		18.2	38.5

* Data not analysed statistically

little cumulative effect of intercropped soybean on N requirement. This might be due to the lack of nodulation in intercropped soybean. Similar increase in N requirement in the absence of effective N fixing capacity of legume component was found by Chang and Shibles (1985) and Ofori and Stern (1987).

In the first set of experiments, N levels linearly increased the grain yield upto 156.5 kg N ha^{-1}. In the revised N levels of the second set of experiments showed an increase in the grain and stover yield up to 187.5 kg N ha^{-1} (N_3) in both sole and intercropped maize. All the yield contributing characters were also positively influenced by an increase in N level up to 187.5 kg N ha^{-1} (Table 1). The major effect of N in increasing grain yield was through an increase in number of grain per cob and grain weight. Similar increase in grain yield in maize through increased application of N was reported by Harold (1984) and Singh *et al.*, (1988). The barrenness of maize was also effectively reduced by enhanced rate of N application (Table 1). Though, the interaction effect of N was absent with systems of cropping, it registered a profound influence with irrigation.

Irrespective of the levels of N, it was better expressed with I_2 level of irrigation than I_1. Yield response per kg of N applied was found to be 12.5 (N_2) and 7.08 (N_3) at lower level of irrigation while it was 15.6 (N_2) and 9.45 (N_3) at higher level of irrigation. Response to N at the two levels of irrigation was found to fit with the second order polynominal curve.

N at I_1 $Y = 1536.987 + 22.5522X - 0.0511X^2$ ($R^2 = 0.999$)

N at I_2 $Y = 1588.732 + 28.093X - 0.0629X^2$ ($R^2 = 0.999$)

The physical and economic optimum dose of N at I_2 level of irrigation was worked out to be 223 and 211 kg N ha^{-1}. Similar high physical and economic dose of N for maize was noticed in N deficient soils by Bhaskaran *et al.* (1993). In short it could be concluded that for sole or intercropped maize for attaining maximum yield, an irrigation with 187.5 kg N ha^{-1} was required in N deficient soils.

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INFLUENCE OF POPULATION AND FERTILIZER LEVELS ON WEED CONTROL METHODS IN SOYBEAN

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ABSTRACT

Results revealed that *Trianthema portulacastrum* a broad leaved weed was the dominant in irrigated field. Hand weeding twice (W_3) followed by thiobencarb at 1.0 kg ha^{-1} plus one hand weeding (W_2) had an effective control of weeds and increased the yield attributes and grain yield of soybean. Fertilizer levels and spacings did not influence the yield. The high net return was obtained under the treatment combination of hand weeding twice adopting a spacing of 30 x 10 cm and a fertilizer dose of 20:80:40 kg N.P.K ha^{-1}. This was followed by application of thiobencarb at 1.0 kg ha^{-1} as pre-emergence herbicide plus one hand weeding under the same spacing and fertilizer levels.

KEY WORDS : Soybean, Weed Control, Fertilizer, Population Levels.

The diet of majority population in developing countries is inadequate and ill balanced due to socio-economic factors. The task of providing a balanced diet is far more challenging that of providing the bare requirement. Soybean, *Glycine max* (L.) Merr, has a good poctential due to its high protein and moderate oil content. Also, it is highly adaptable to varying soil and climatic conditions. Fertilizer use continues to be the major factor for increasing the soybean yield and productivity with the availability of input intensive high yield soybean varieties. There has been a considerable increase in the application of fertilizers supplying the major nutrients. Plant population is also a factor influencing soybean production so as to obtain maximum yield. It has been estimated that 33 per cent of potential production is lost due to weed competition besides the loss of valuable plant nutrients in the form of weed removal. The reduction in yield of soybean ranged from 10 to 73 per cent due to weed competition as seen from various studies. A number of pre-emergence herbicides are used for early control of weeds in soybean. Soybean cro receiving sufficient