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Effect of Irrigation, Mulching and Fertility Levels on Mustard (*Brassica juncea*) and their Residual Effect on Succeeding Goundnut (*Arachis hypogaea*) Crop

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ABSTRACT

A field experiment conducted on clayey soil at Junagadh revealed that frequent irrigations at 0.8 IW/CPE ratio recorded significantly higher plant height, siliquae/ plant, seed weight/plant, oil content, nutrient uptake and yield of mustard than 0.5 IW/CPE ratio. Mulching with wheat straw increased plant height, seed weight/plant, 1000-seed weight, nutrient uptake, water use efficiency and yield of mustard. A marked increase in all the growth and yield parameters, nutrient uptake, water use efficiency and the yield of mustard was observed with each increase in fertilizer levels from 0 to 100% of the recommended dose, while oil content in seed was decreased. Application of FYM @ 10 t/ha significantly increased the growth and yield attributes, nutrient uptake, water use efficiency and yield of mustard. Residual effect of wheat straw mulch and FYM treatments increased plant height, filled pods/plant and pod and haulm yields of succeeding groundnut crop.

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INTRODUCTION

The mustard crop offers a good scope for diversification of cropping pattern in the *rabi* season, particularly in areas with limited water supply. It is also gaining popularity among the farmers of Saurashtra region, where groundnut is an important traditional rainy season crop. Water and nutrient management is considered the most important factors in production of mustard crop. However very little work has been carried out on the residual effect of organic mulches and manuring on the succeeding crops grown in a sequence. Therefore, a field experiment was undertaken with integrated approach to have appropriate use of limited available resources efficiently under south Saurashtra conditions.

MATERIALS AND METHODS

The field experiment was conducted during winter and rainy seasons of 1992-93 and 1993-94 at Junagadh on fixed plots. The soil was clayey in texture, slightly alkaline (pH 7.9) and contained 0.83% organic carbon, 29.7 kg P_2O_5/ha and 289.0 kg K_2O/ha. Twenty four treatments consisting of 2 levels each of irrigation (0.5 and 0.8 IW/CPE ratio) and mulching (no mulch and wheat straw mulch @ 10 t/ha) in main plots and 3 levels of fertilizer

(0, 50 and 100% of the recommended dose of 50 kg N + 50 kg P_2O_5/ha) and 2 levels of farmyard manure (no FYM and FYM @ 10 t/ha) in sub plots were laid out in split plot design with 3 replications. Half of the N and all of the P in the form of urea and single superphosphate, respectively were applied as per treatment at sowing and remaining half of N through urea was topdressed one month after sowing of mustard. Farmyard manure was incorporated before sowing of mustard crop, while mulching was done at 21 days after sowing. No fertilizer or manure was applied to the *kharif* groundnut crop for studying the residual effect of different treatments given to preceding mustard crop.

The measured quantity of water (50 mm depth) was applied with the help of parshall flume. Two common irrigations were given to mustard crop during both the years for uniform emergence and establishment of plantstand. The irrigations applied under 0.5 and 0.8 IW/CPE ratios were 5, 7 and 4, 6 in 1992-93 and 1993-94, respectively. Three supplementry irrigations were given to groundnut grown in *kharif*, 1993 because of dry condition prevailed during crop growing season. Total amount of rainfall received during 1993 and 1994 were 526.8 and 1181.3 mm, respectively. Thus, the rainfall received during 1994 was found higher than the normal.

RESULTS AND DISCUSSION

Effect on mustard

Irrigation scheduled at 0.8 IW/CPE ratio recorded significantly higher plant height, siliquae/plant, seed weight/plant and oil content in seed than 0.5 IW/CPE ratio (Table 1). Improved growth and yield attributes with increased irrigation frequency at 0.8 IW/CPE ratio significantly increased the seed and stover yields over 0.5 IW/CPE ratio (Table 1). Frequent irrigations at 0.8 IW/CPE ratio also increased the N and P uptake by seed and stover of mustard (Fig. 1). The results confirm the findings of Malavia *et al.* (1988) and Tomar *et al.* (1990).

Mulching treatment significantly increased plant height, seed weight/plant, 1000-seed weight and also the N and P uptake by seed and stover of mustard, which resulted in significantly higher seed and stover yields over no mulch treatment in pooled results (Table 1). The beneficial effect of mulching was attributed to favourable hydrothermal regime leading to improved rhizosphere environment. Mulching with straw also increased water use efficiency (Table 1). This may probably be due to its favourable effect on soil moisture conservation and increased seed yield. The results are in accordance with the findings of Singh *et al.* (1990).

Each increment in fertilizer level from 0 to 100% of the recommended dose significantly increased the seed and stover yields of mustard (Table 1). Appreciable increase in growth and yield attributes viz., plant height, siliquae/plant, seed weight/plant and 1000-seed weight (Table 1) as well as increase in nutrients uptake by seed and stover (Fig. 1) as a result of fertilizer application might have increased the yield of mustard crop. The water use efficiency increased, while oil content in seed decreased with increasing level of fertilizer. The decrease in oil content might be due to the dilution effect of higher seed yield. The results confirm the findings of Singh (1983).

TABLE 1

Influence of irrigation, mulching and fertility levels on yield and yield attributes of mustard.

Treatments	Seed yield (kg/ha)			Stover yield (kg/ha)	Oil content (%)	Water use efficiency kg/ha/mm	Plant height (cm)	Siliquae plant	Seed weight /plant	1000-seed (g)
	1992-93	1993-94	Pooled							
Irrigation IW/CPE										
0.5	1083	850	966	2595	35.89	5.04	146.7	233.7	7.82	3.81
0.8	1236	1012	1124	3117	36.22	4.95	156.9	252.5	8.98	3.87
C. D. at 5 %	100	74	57	193	0.24	—	3.0	18.3	0.84	NS
Mulch (t/ha)										
0	1109	899	1004	2751	35.94	4.56	149.5	237.6	7.95	3.78
10	1210	963	1087	2962	36.17	5.43	154.0	248.7	8.85	3.90
C. D. at 5 %	100	NS	57	193	NS	—	3.0	NS	0.84	0.11
Fertilizer dose (%)										
0	895	625	760	2064	36.30	3.76	142.7	175.6	6.02	3.83
50	1181	949	1065	2904	36.07	5.06	154.1	247.1	8.69	3.85
100	1402	1219	1310	3600	35.80	6.16	158.5	306.6	10.49	3.84
C. D. at 5 %	67	57	47	92	0.22	—	1.8	17.2	0.64	NS
FYM (t/ha)										
0	1114	831	972	2719	36.14	4.61	149.9	231.9	7.90	3.80
10	1205	1031	1118	2993	35.97	5.38	153.7	254.3	8.90	3.88
C. D. at 5 %	55	46	38	75	NS	—	1.5	14.0	0.52	0.08

Residual effect of different treatments on pod and haulm yields and yield attributes of succeeding groundnut.

Treatments	Pod yield (kg/ha)			Haulm yield (kg/ha)	Oil content (%)	Plant height (cm)	Filled pods/plant
	1993	1994	Pooled				
Irrigation (IW/CPE)							
0.5	951	582	766	1551	49.36	24.5	7.1
0.8	998	652	825	1629	49.54	25.0	7.2
C. D. at 5 %	NS	NS	NS	NS	NS	NS	NS
Mulch (t/ha)							
0	965	556	760	1560	49.47	24.1	6.8
10	983	678	831	1621	49.43	25.5	7.5
C. D. at 5 %	NS	83	60	NS	NS	1.0	0.7
Fertilizer dose (%)							
0	999	639	819	1592	49.59	25.0	6.9
50	954	620	787	4595	49.39	24.8	7.3
100	969	593	781	1583	49.37	24.6	7.1
C. D. at 5 %	NS	NS	NS	NS	NS	NS	NS
FYM (t/ha)							
0	959	580	769	1545	49.49	24.5	6.9
10	989	654	822	1635	49.41	25.1	7.4
C. D. at 5 %	NS	52	32	65	NS	0.4	0.4

Application of FYM @ 10 t/ha to mustard crop produced significantly higher seed and stover yields and increased water use efficiency than no FYM treatment (Table 1). Manuring with FYM significantly increased plant height, siliquae/plant, seed weight/ plant and 1000-seed weight as well as the N and P uptake by seed and stover, which in turn have increased the yield. However, it did not affect the oil content in seed. Organic manure acts as nutrient reservoir for plant and it also increases water availability through increasing water holding capacity of the soil. Khurana *et al.* (1991) also obtained similar results.

Residual effect on groundnut

Irrigation levels applied to preceding mustard crop did not show significant residual effect on yield parameters, yield and oil content of groundnut (Table 2). The pooled results showed that the incorporation of wheat straw mulch into the soil significantly increased plant height, filled pods/plant and pod yield of groundnut (Table 2). However, it had no residual effects on haulm yield and oil content in pooled results. The beneficial residual effects of mulching might be associated with the availability of all the essential nutrients in organic matter due to its continuous mineralization. The results are in agreement with those of Reddy *et al.* (1991).

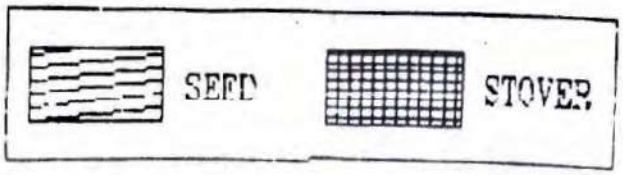
Application of fertilizers to mustard crop did not manifest significant residual effect on plant height, filled pods/plant, pod and haulm yields as well as oil content in kernels (Table 2). This was probably due to the fact that the requirement of the groundnu for N and P has been met by the soil itsel and through N-fixation from atmosphere Parida (1987) also reported similar results ir groundnut crop at Junagadh.

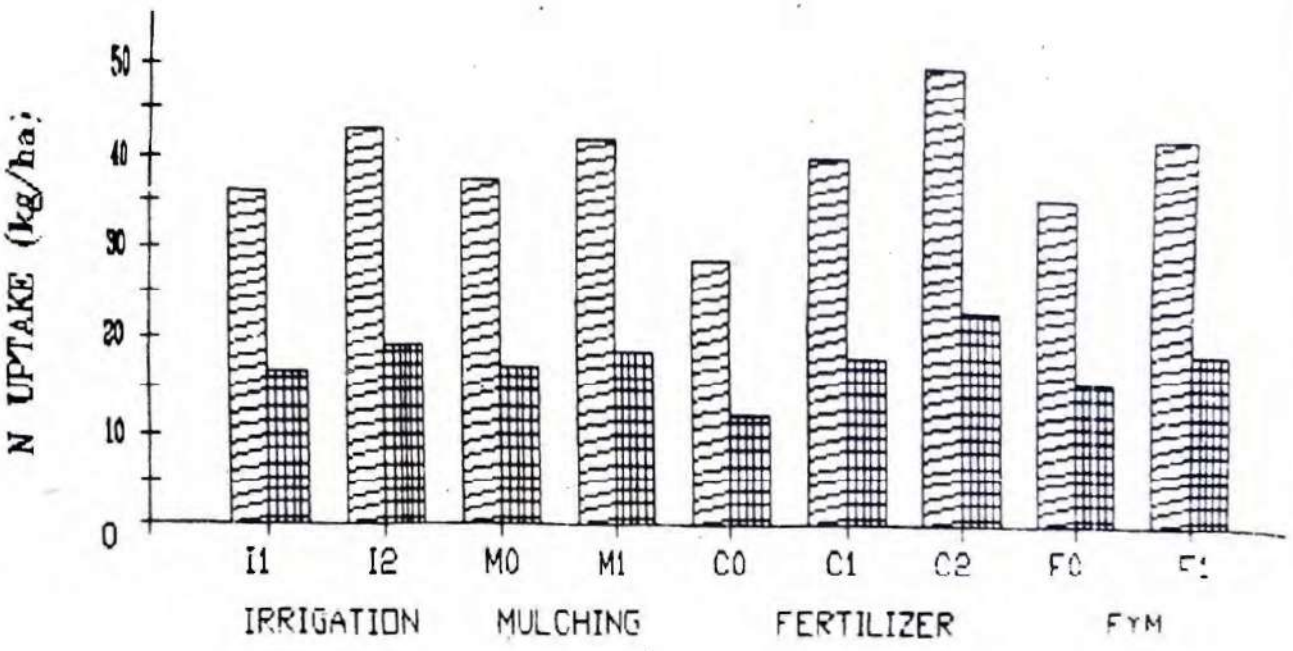
It was observed that FYM treatment show significant residual effect on pod and haulm yields of succeeding groundnut crop in pooled results (Table 2). However, it had no appreciable influence on oil content in kernels. Higher yields under FYM treatment was attributed tc improved growth and yield attributes viz., plan height and filled pods/plant. The results confirm the findings of Khurana *et al.* (1991).

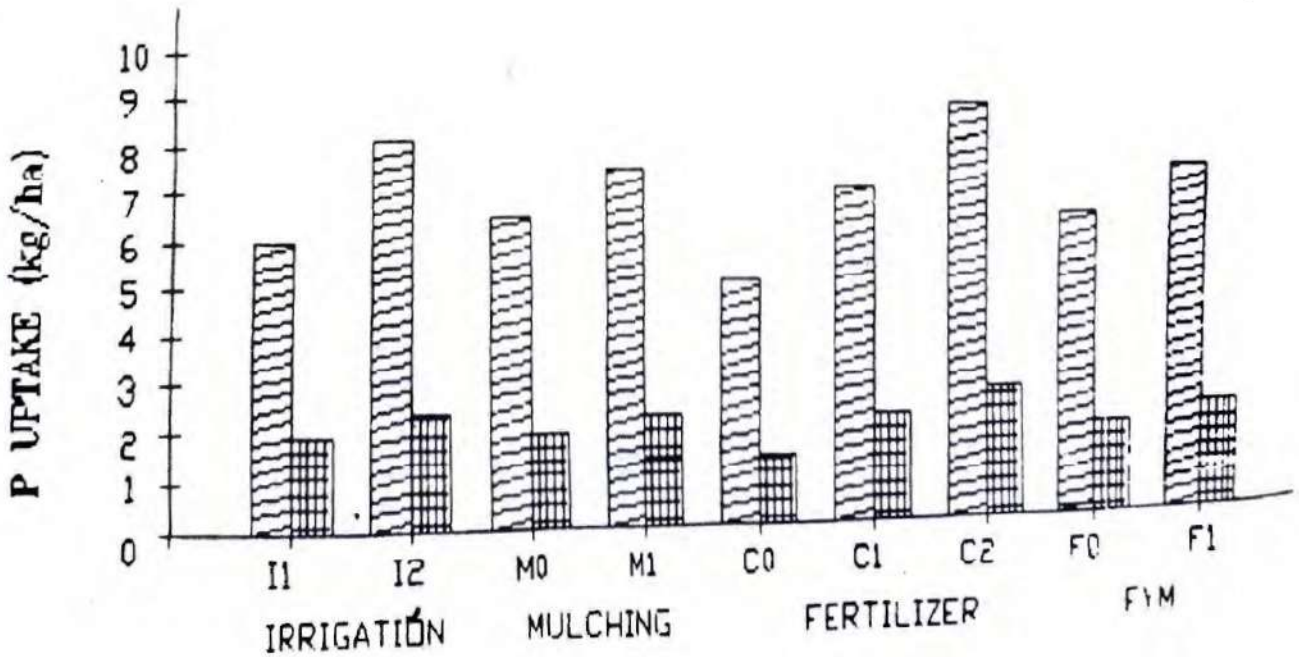
TABLE 3

Residual effect of irrigation and fertilizer interaction on filled pods/plant and pod yield of groundnut in pooled results.

Fertilizer dose (%)	*Irrigation (IW/CPE)*			
	Pod yield (kg/ha)		*Field pods/plant*	
	0.5	*0.8*	*0.5*	*0.8*
0	812	826	7.4	6.4
50	780	794	7.4	7.2
100	707		6.6	7.6
C. D. at 5%			0.7	


SEED
STOVER


N UPTAKE (kg/ha)
0
10
20
30
40
50
I1
I2
M0
M1
C0
C1
C2
F0
F1
IRRIGATION
MULCHING
FERTILIZER
FYM


P UPTAKE (kg/ha)
0
1
2
3
4
5
6
7
8
9
10
I1
I2
M0
M1
C0
C1
C2
F0
F1
IRRIGATION
MULCHING
FERTILIZER
FYM

Interaction effect

The residual effect of interaction between irrigation and fertilizer levels revealed that the highest values of filled pods/plant and pod yield of groundnut crop were recorded under frequent irrigations at 0.8 IW/CPE ratio with full recommended fertilizer dose applied to the previous crop (Table 3). Scheduling irrigation at 0.5 IW/CPE ratio with full recommended fertilizer treatment in mustard produced significantly the lowest pod yield of groundnut crop indicating beneficial residual effect of the highest level of irrigation. This might be due to the fact that fertilization increases the nutrient supply, while frequent irrigations mobilized the nutrients in soil (Patel and Saraf, 1991).

The results suggest that frequent irrigations at 0.8 IW/CPE ratio alongwith wheat straw mulch and full recommended fertilizer dose alongwith FYM application were essential to harvest full potential of mustard crop. Mulching with wheat straw and manuring with FYM into mustard were also found beneficial to the succeeding groundnut crop.

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