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Effect of irrigation and mulch on yield, consumptive use of water and water use efficiency of summer groundnut

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ABSTRACT

Application of 3 irrigations at flowering, pegging and pod development stages along with mulching and as well as their interaction gave the highest pod yield, haulm yield and harvest index of summer groundnut. Seasonal consumptive use of water was increased with the application of frequent irrigation, although water use efficiency was reduced. The highest consumptive use of water was obtained when 4 irrigations were applied at branching, flowering, pegging and pod development stages and under no mulch condition, although the maximum water use efficiency was recorded under rainfed condition and with mulch treatment.

Key words : Irrigation, Mulch, Yield, CU, and WUE, Summer groundnut.

To meet the ever increasing demand of vegetable oil, improvement of production of major oilseed crops through area expansion and productivity through adoption of improved technology is most important. Among the oilseed crops groundnut is the king contributing about 45% of total area and 55% of total production under oilseeds in the country. But today the king is loosing some ground in competition with other oilseeds.

Although moisture is the key factor of production but mismanagement of water like improper scheduling, lack of drainage etc. often leads to reduction in crop yield. For efficient utilization of applied water scheduling of irrigation to the crop would be on the scientific manner. Application of mulch materials can be of great use for conserving moisture, regulating soil temperature and for suppression of weeds during early stage of crop. Considering all the above facts in view, the present investigation was conducted to evaluate the effect of different levels of irrigation and mulch on performance of summer groundnut.

MATERIALS AND METHODS

The experiment was conducted at Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, W.B., duping *Pre-kharif* seasons of 2003 and 2004 on sandy loam soils having neutral pH and medium fertility status.

The experiment was laid out in a split plot design having 5 main plot treatments on different levels of irrigation i.e. T_4 (4 irrigations given at branching, flowering, pegging and pod development stage, T_3 (3 irrigations applied at flowering, pegging and pod development stage), T_2 (2 irrigations scheduled at pegging and pod development stage), I_1 (1 irrigation given at pod development stage) and I_0 (rainfed) and 2 sub-plot treatments i.e. M_1 (mulching with rice straw at 6 t ha^{-1}) and M_0 (no mulching), which were replicated thrice. The treatments were randomly allocated in both main and sub-plots. Groundnut (Cv. TAG 24) was sown in rows with 30 cm X 10 cm spacing on 14th and 27th February of 2003 and 2004 respectively using a seed rate at 80 kg ha^{-1} and harvest after 108 days of sowing. The crop was fertilized at the rate of 40 : 60 : 40 kg ha^{-1} as N : P_2O_5 : K_2O, applied as basal. Soil samples were collected with the help of a screw auger from 4 soil layers i.e. 0-15, 15-30, 30-45 and 45-60 cm at sowing, before and 24 hours after each irrigation, harvesting and after rain for calculating moisture percentage, consumptive use (CU) of water and water use efficiency (WUE).

RESULT AND DISCUSSION

Pod Yield

The pod yield was increased significantly with the increase in irrigation level and the highest pod yield was obtained with I_3 level of irrigation, which was 63.5% higher over rainfed (I_0). Pod yield was decreased under frequent irrigation (I_4) by 7.52% as compared to I_3 level of irrigation (Table 1). Decreased pod yield with I_4 level of irrigation might

Table 1 Effect of irrigation, mulch and their interaction on pod yield, haulm yield and harvest index of summer groundnut (pooled data)

Treatments	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest Index (%)
I_0	2210.8	6212.8	26.25
I_1	2612.4	7034.4	27.09
I_2	3020.9	7465.3	28.81
I_3	3615.3	8259.5	30.46
I_4	3343.3	7832.8	29.90
S.Em (±)	9.73	34.23	0.08
CD at 5%	29.17	102.62	0.24
Mulch			
M_0	2898.3	7232.2	28.41
M_1	3022.7	7489.7	28.60
S.Em (±)	4.81	18.42	0.06
CD at 5%	14.18	54.35	0.18
Interaction			
I_0M_0	2109.6	5955.3	26.16
I_0M_1	2312.1	6470.3	26.34
I_1M_0	2536.9	6930.9	26.81
I_1M_1	2687.8	7137.9	27.36
I_2M_0	2899.2	7364.5	28.26
I_2M_1	3142.6	7566.1	29.36
I_3M_0	3371.9	7699.2	30.47
I_3M_1	3858.6	8819.7	30.44
I_4M_0	3573.9	8211.2	30.33
I_4M_1	3112.4	7454.4	29.47
S. Em (±)	10.75	41.20	0.14
CD at 5%	a) 31.72	a) 121.53	a) 0.40
	b) 52.08	b) 189.29	b) 0.53

N.B. Interaction CD (a) for comparing sub-plot means (mulch) at same level of main plot (irrigation)
Interaction CD (b) for comparing main plot means at same or different levels of sub-plot.

be due to poor aeration in the root zone resulting from frequent irrigation which consequently retarded nodulation and growth characters and ultimately yield attributes and yield was reduced. Padma and Rao (1992) also reported the same.

Mulch increased the pod yield of groundnut significantly (Table 1). The higher yield with mulch was attributed due to conservation of soil moisture and regulation of soil temperature by mulch which led to production of higher yield attributes and ultimately higher pod yield. Several workers also made similar type of observations (Cheong *et al.*, 1995 and Sanjeev *et al.*, 2001).

The interaction effect between levels of irrigation and mulch was also significant (Table 1). Among the different treatment combination I_3M_1 i.e. application of 3 irrigation alongwith mulching recorded the highest pod yield.

Haulm yield

Haulm yield was significantly influenced by irrigation level and the highest haulm yield was recorded at I_3 level of irrigation. As expected, I_0 treatment recorded the lowest haulm yield (Table 1). Reduction in plant height, branch per plant, dry matter accumulation and canopy development under rainfed condition due to moisture stress ultimately reduced the haulm yield of groundnut. Similar results were also reported by Jadav *et al.*, (1989).

Haulm yield was 3.6% higher under mulched condition over no mulch (Table 1). This might be due to better growth and development of crop under mulched condition resulting from better moisture conservation and creation of more congenial growing condition under mulching, Kathmale *et al.* (2000) also observed that haulm yield was significantly more under mulched condition as compared to unmulched one.

The interaction effect between levels of irrigation and mulch on haulm yield of groundnut was also significant. Mulching with all the levels of irrigation always produced higher haulm yield over no mulching except at I_4 and among the treatment combinations, I_3M_1 recorded the highest haulm yield (Table 1).

Harvest Index

Harvest index was significantly increased with the increase in irrigation frequency from I_0 to I_4 and the highest value was recorded in I_3 level of irrigation (Table 1). However, the lowest harvest index was always obtained under rainfed condition due to production of lower yield under stress condition. The beneficial effect of irrigation on harvest index was also observed by Patra *et al.* (1998).

Mulching as well as the interaction effect between levels of irrigation and mulching also had significant influence on harvest index of groundnut. Mulching gave higher harvest index than no mulching. However, among the treatment combinations I_3M_0, I_3M_1 and I_4M_0 were at par and I_4M_1 gave reduced harvest index due probably to the excess moisture condition of the soil. I_0M_0 combination recorded the lowest value of harvest index (Table 1).

Consumptive Use (CU)

Seasonal CU of water was increased with the increased level of irrigation and the highest CU was recorded when 4 irrigations were applied at

branching, flowering, pegging and pod development stages, which were closely, followed by I_3 level of irrigation during both the years and in mean data (Table 2). Frequent irrigation filled the root zone depth of groundnut crop with water upto field capacity very frequently and kept the soil moisture status in the root zone depth at higher level. The evapo-transpiration therefore proceeded at a faster rate leading to greater CU. The results are in conformity with the findings of Singh *et al.*, (1994).

production of higher pod yield and at the same time lower CU of water under this treatment.

CONCLUSION

From the above discussion it can be concluded that 3 irrigations at flowering, pegging and pod development stages should be provided to the summer groundnut along with mulching to maximize the productivity. Increase in the frequency of irrigation enhanced CU of water while WUE was reduced due

Table 2 Effect of irrigation and mulch on consumptive use and water use efficiency of summer groundnut

Treatments	Consumptive use (cm)			Water Use Efficiency (Kg ha^{-1} mm^{-1})		
	2003	2004	Mean	2003	2004	Mean
Irrigation						
I_0	26.93	24.46	25.70	8.20	9.04	8.62
I_1	34.15	32.11	33.13	7.52	8.28	7.90
I_2	41.33	43.48	42.41	7.30	6.95	7.13
I_3	50.69	51.00	50.85	7.01	7.21	7.11
I_4	53.88	52.80	53.34	6.20	6.34	6.27
Mulch						
M_0	43.90	43.70	43.80	6.49	6.74	6.62
M1	38.88	37.83	37.86	7.78	7.99	7.89

CU of water was lower under mulched condition as compared to unmulched treatment (Table 2). This might be due to the fact that mulches created a protective cover on the soil surface and thus helped to keep the soil moisture at an optimum level through adequate monitoring of evapo-transpiration. The results are corroborated with the findings reported by Shajari *et al.* (1990).

Water use efficiency (WUE)

Data recorded in Table 2 indicated that increased level of irrigation greatly reduced the wide WUE of groudnut crop and the highest WUE was obtained under rainfed condition. However, I_1 i.e. application of one irrigation at pod development stage recorded higher WUE during both the years and in mean data than other level of irrigation. Lower CU of water under rainfed condition might be the main reason for maximum WUE. Similar results were also recorded by Tiwari *et al.*, (1994).

Straw mulches had a positive influence on WUE of groundnut crop (Table 2). Higher WUE under mulched condition was obtained due to to increase in frequency of irrigation. Mulching also enhanced WUE of groundnut.

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