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Response of summer groundnut (*Arachis hypogaea*) to irrigation regimes and mulching

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ABSTRACT

A field experiment was conducted during summer seasons of 1999–2001 at Rahuri, Maharashtra, to find out appropriate irrigation schedule for summer groundnut (*Arachis hypogaea* L.) and to evaluate the effect of mulch on crop performance in broad bed-furrow method. Twenty-four treatment combinations, comprising 4 irrigation regimes based on cumulative pan evaporation (CPE), viz. 75, 100, 125 and 150 mm CPE, and 6 mulching treatment, viz. sugarcane trash @ 5 tonnes/ha and plastic film mulch (7 micron) with and without kaoline 8% and the control. Among all the irrigation regimes, irrigation scheduled at 75 mm CPE to summer groundnut recorded significantly higher yield parameters, dry pod yield (34.08 q/ha) and net returns (Rs 32,012/ha) in broad bed furrow (60–30 cm × 6.67 cm) than 100, 125 and 150 mm CPE. Mulching of plastic film with kaoline spray (8%) was found effective and registered highest pod yield (34.70 q/ha) over rest of treatments. The net returns obtained owing to mulching with plastic film and sugarcane trash with and without kaoline spray were almost identical. The benefit : cost ratio indicated that the use of sugarcane trash @ 5 tonnes/ha was found economically feasible agronomic practice for summer groundnut. The total consumptive use of water (738 mm) was higher with minimum water-use efficiency (4.61 kg/ha-mm) when irrigation was scheduled at 75 mm CPE. The water-use efficiency was higher with use of plastic film mulch with kaoline (6.69 kg/ha-mm) and was lowest with the control (3.49 kg/ha-mm). On an average, the evapotranspiration losses were reduced to the extent of 25.77, 14.63 and 4.56% due to application of plastic film, sugarcane trash and kaoline spray, respectively.

Key words : Summer groundnut, Irrigation regimes, Mulching, Yield and Economics

In Maharashtra, groundnut (*Arachis hypogaea* L.) occupies dominant position as an oilseed crop and the crop is increasingly grown under irrigation during summer season in command areas as a cash crop. Area under groundnut cultivation in the state is about 0.52 million hectare with production of 0.55 million tonnes and productivity of 1,049 kg/ha. Out of this about 20% area comes under summer cultivation. It has great potential to increase the yield under summer season. This crop is more sensitive to water fluctuation and more or less at critical growth stages, which adversely influences the yield. Therefore, there is a need of efficient and economic use of irrigation water, so as to increase the area and productivity of summer groundnut. Borole (1986) recorded maximum yield of summer groundnut when irrigation was scheduled at 75 mm CPE. The broad bed furrows (BBF) techniques provides loose soil mass for developments of pods, besides, the furrows were beneficial for irrigation and drainage of excess water, Bhoi *et al.* (1984) and Nalwade and More (1993) reported significant response of BBF resulting in higher pod yield, therefore this technique was used. In recent year's use of plastic film, straws and antitranspirant have been used for minimizing water losses through evapotranspiration. The present experiment was therefore carried out, to find out appropriate irrigation schedule to increase the productivity of summer groundnut and to evaluate the effect of mulch on crop performance in broad bed furrows.

MATERIALS AND METHODS

A field experiment was conducted during 1999–01 during summer at Rahuri. The soil was clay loam, with organic carbon 0.45% available N 350 kg/ha, available P 18.7 kg/ha and available K 375 kg/ha, with pH 8.5. The soil-moisture content at 1/3 bar and 15 bar was 38.7 and 20.5% respectively. The bulk density was 1.28 g/cm^3. Twentyfour treatment combinations, comprising 4 irrigation regimes based on cumulative pan evaporation (CPE),

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viz. 75, 100, 125, 150 mm CPE, in main plots and 6 mulching with antitranspirant treatments in subplots, viz. sugarcane trash @ 5 tonnes/ha and plastic film mulch (7 micron) with and without kaoline 8% spray, kaoline 8% and control. The experiment was laid out in split plot design with 3 replications. Groundnut 'TG 26' was sown on broad bed-furrow with spacing of 60–30 x 6.67 cm during the last week of February and harvested in the last week of June each year.

Recommended dose of N and P was applied as a basal dose at the time of sowing. Plastic film (7 micron) and sugarcane trash mulch @ 5 tonnes/ha were applied immediately after germination of crop as per treatments. In all 5 sprays of kaoline (8%) were applied in the treatments of antitranspirant at 15-day intervals starting from 45 days after sowing. The other recommended cultural practices followed were common in all other treatments. Two common irrigations (14 cm depth) were applied for better germination and establishment of crop. The remaining irrigations were given as per treatments when cumulative pan evaporation reached the required value and the quantity of water applied was measured with the help of Roplogle flume. Water use-efficiency was computed in terms of pod yield (kg/ha-mm) by dividing yield of pod with consumptive use of water. The input cost of plastic film mulch (52 kg) was Rs 3,640/ha and kaoline (200 kg) Rs 970/ha. The market rates received to dry pods were Rs 1500/q in first 2 seasons and Rs 16,00/q in third season respectively.

RESULTS AND DISCUSSION

Yield and yield parameters

Significantly reduction was observed in yield parameters, oil and shelling (%) due to increasing levels of irrigation regimes from 75 to 150 mm CPE (Table 1). The moisture stress prevailed due to higher CPE values, adversely affected the yield parameters. An application of irrigation at 75 mm CPE resulted significantly higher dry pod yield of groundnut (34.08 q/ha) than the rest of irrigation treatment on broad bed furrow. The yield decreased significantly with increasing levels of CPE and was lowest at 150 mm CPE (26.99 q/ha). The favourable soil-moisture conditions created in the rhizosphere at 75 mm CPE benefiting in giving higher pod yield Mahakulkar *et al.* (1990) and Parihar *et al.* (1999) also reported similar trend. The differences in yield and yield parameters were significant due to mulching with antitranspirant. The use of 7 micron plastic film with koline (8%) spray gave significantly higher pod yield of summer groundnut (34.69 q/ha) over rest of mulching treatments on pooled mean basis. Similar trend was noticed in yield and yield parameters and quality aspects during each season also.

However, the use of sugarcane trash @ 5 tonees/ha resulted 17.08% higher dry pod yield than the control (26.5 q/ha). Plastic film and sugarcane trash might have enhanced microbial activities due to favourable soil moisture and soil-temparature condition in rhizosphere of groundnut, resulting in quick release of nutrients and their uptake, which ultimately increased the pod yield of groundnut (Shyam Sunder, 1999). The use of kaoline spary 8% alone gave only 3.83% higher dry pod over the control (26.05 q/ha) and it was not found much effective in reducing ET losses. Shinde and Lomate (1979) also reported that, application of kaoline (3%) to summer groundnut did not influence the yield significantly. The oil (%) increased significantly under mulching than the control.

Table 1. Effect of irrigation regimes and mulching on yield and yield parameters of summer groundnut (pooled of 3 seasons)

Treatment	Pods plant	Drypod weight/ plant (g)	100 pod weight (g)	100-kernel weight (g)	Dry pod yield (q/ha)				Shelling (%)	Oil (%)
					1999	2000	2001	pooled		
Irrigatin regimes										
75 mm CPE	25.65	24.45	99.73	55.82	34.29	34.96	33.00	34.08	68.50	51.78
100 mm CPE	22.94	21.08	96.36	51.77	32.96	33.08	30.46	32.16	67.58	51.44
125 mm CPE	20.07	17.59	94.02	49.47	30.09	30.54	27.56	29.39	66.72	51.07
150 mm CPE	16.43	14.63	90.99	47.60	27.92	27.90	25.15	26.99	65.72	50.56
CD(P=0.05)	2.39	2.00	2.56	0.90	0.80	1.34	1.96	0.83	0.62	0.30
Mulching regimes										
Cane trash@ 5 tonnes/ha	20.94	19.30	94.52	50.86	31.80	31.35	29.56	30.50	67.00	51.03
Plastic film (7 micron)	22.71	20.45	97.11	51.89	34.38	33.24	31.91	33.17	67.40	51.68
Kaoline 8%	19.63	18.26	93.59	50.22	27.21	28.67	25.41	27.09	66.92	50.80
Sugarcane trash @5 tonnes/ha + Kaoline 8%	21.85	19.86	95.78	51.34	32.78	32.80	30.68	32.08	67.15	51.38
Plastic film + kaoline 8%	24.29	21.32	98.31	52.35	35.58	35.30	33.21	34.69	67.56	51.80
Control (No mulch)	18.21	17.48	92.35	49.59	26.33	27.36	24.48	26.05	66.75	50.59
CD (P=0.05)	1.19	0.91	3.70	NS	1.12	1.69	1.25	0.77	NS	0.28

Table 2. Water requirenent and econmics of summer groundnut as influenced by different treatments (Average of 3 seasons)

Treatment	Profile depletion (mm)	Effective rainfall (mm)	Irrigation depth (mm)	Consum-ptive use (mm)	Total water use (mm)	WUE (kg/ha) (mm)	Net returns (Rs/ha)				Benefit : cost ratio
							1999	2000	2001	Pooled	
Irrigation regimes											
75 mm CPE	687	51	751	738	802	4.61	31,631	31,599	32,805	32,011	2.60
100 mm CPE	583	67	660	650	727	4.94	29,976	30,141	29,109	29,741	2.52
125 mm CPE	513	72	564	585	636	5.02	26,227	26,711	24,833	25,923	2.35
150 mm CPE	456	84	494	540	578	4.99	23,220	22,932	21,160	22,437	2.18
CD (P=0.05)	-	-	-	-	-	-	910	2,016	3,145	12,81	-
Mulching regimes											
Cane trash @ 5 tonnes/ha	567	69	618	636	687	4.79	30,185	29,813	28,322	29,440	2.73
Plastic film (7 micron)	484	69	618	553	687	5.96	30,599	29,198	30,236	30,011	2.44
Kaoline 8%	643	69	618	712	687	3.81	22,366	23,787	21,283	22,478	2.16
Cane trash @ 5 tonnes/ha + kaoilne 8%	540	69	618	609	687	5.27	30,003	30,164	29,896	30,021	2.57
Plastic film + kaoline 8%	450	69	618	519	687	6.69	30,466	30,474	30,497	30,479	2.35
Control (no mulch)	677	69	618	746	687	3.49	22,961	23,637	21,615	22,738	2.30
CD (P=0.05)	-	-	-	-	-	-	1,605	2,538	1,693	1,311	-

Economic returns

Irrigation scheduled at 75 mm CPE to summer groundnut recorded significantly higher net returns (Rs 32,012/ha) and benefit : cost ratio (2.60) than rest of irrigation treatments. Net returns were significantly reduced with each increased level of CPE. Similarly, the net returns were significantly higher dry the use of plastic film mulch with kaoline spray over use of kaoline spary alone and the control. However, the net returns obtained due to mulching with plastic film and sugarcane trash with and without kaoline spray were almost equally identical indicating that, the use of sugarcane trash @ 5 tonnes/ha for summer groundnut was economical beneficial interms on net returns and benefit : cost ratio (2.73). Shinde and Firake (1998) also reported that use of sugarcane trash significantly increased the benefit : cost ratio and net returns in summer chilli compared with plastic film. Use of kaoline spray (8 %) resulted in the minimum net returns and hence it was not beneficial in summer groundnut.

Irrigation studies

Irrigation regimes had a marked influence on water use and water-use efficiency. The average irrigation required that to summer groundnut was 618 mm. The profile depletion of water, total water requirement and consumptive use was maximum when irrigation was scheduled at 75 mm CPE, with minimum water-use efficiency (4.61 kg/ha/mm). The mean consumptive use at 75 mm CPE (738 mm) was 36.66 % higher than 150 mm CPE (540 mm).

This indicates that delayed irrigation were not congenial for obtaining high WUE in summer groundnut. The profile depletion and consumptive use was lowest in the treatments of plastic film in combination with kaoline spray as compared to the rest treatments but it was highest in control treatments. The water use-efficiency was 3.49- 6.69 kg/ha mm and it was higher in use of plastic film mulch with kaoline (6.69 kg/ha/mm) and was lowest with the control (3.49 kg/ha-mm). These indicate that the water was most efficiently utilized under the plastic film mulch. On an average, the ET losses were reduced to the extent of 25.77, 14.63 and 4.56 % due to application of plastic film, sugarcane trash and kaoline spray, respectively.

Thus growing of summer groundnut on broad-bed furrow with irrigation scheduled at 75 mm CPE using plastic film was beneficial for achieving higher productivity and reducing the ET losses. Use of sugarcane trash @ 5 tonnes/ha, as mulch was equally beneficial in terms of net returns and benefit : cost ratio as that of plastic film mulch.

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