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Influence of growth regulators on performance of sesame under varying irrigation levels

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ABSTRACT

A field experiment was carried out during 1995 and 1996 summer season to study the effect of irrigation levels and growth regulators on yield components and yields of sesame. Three levels of irrigations, viz., irrigating the crop at 30, 45 and 60 days after sowing (DAS), at 45 and 60 DAS and at 30 and 60 DAS were allotted in main plots. In sub-plots, Paclobutrazol and Cycocel were applied with two concentrations (100 and 200 ppm) besides, water soaked and dry seeds (control). Magnitude of number of capsules plant^{-1}, number of seeds capsule^{-1}, test seed weight, seed and stover yields were decreased when irrigation was applied twice only. Skipping irrigation at 45 DAS (flowering) had more impact on crop properties than at 30 DAS. Cycocel acted better in arresting the ill effect of water stress. Variation in growth regulator concentrations had resulted no significant effect in crop.

Key words: Irrigation, Paclobutrazol, Cycocel, Sesame.

Sesame is an important oilseed crop in Gangetic Plains of India. This crop is grown in a period when atmospheric evaporative demand is high and availability of irrigation water is low. Under these circumstances, there is a need for efficient utilization of water resources (Mermould, 2005) or physiological manipulation of the crop with growth regulator to overcome the water stress situation (Tian *et al*., 1993). Scarcity of water resource developed the concept of limited irrigation where crops are partially wetting or skipping irrigation at certain growth stage (Deng *et al*, 2006). Lower transpiration rate under water stressed condition affects the status of photosynthesis (Hillel, 1998), where application of growth regulator could trigger the metabolic activities of the crop (Zhai and Zhang, 1994). With the above backgrounds in view, a field investigation was carried out to evaluate the impact of irrigation frequencies and growth regulators on yield components as well as yield of sesame.

MATERIAL AND METHODS

Field trials were carried out during the summer seasons 1995 and 1996 at the research farm of Institute of Agriculture, Sriniketan, located at 23^{o} 39$^{/}$ N, 87^{o} 42$^{/}$ E and altitude 58.9 m above mean sea level. The research farm is situated in red and lateritic zone of West Bengal. Soil of the experimental site was sandy loam, with moderate acidic pH (5.6) and low organic carbon status (0.38%). The experiment was laid out in a split-plot design in three replicates with three irrigation regimes randomly allotted in three main plots while six levels of growth regulators were randomly allotted in sub-plots of each main plot. Sub-plot size was (5 x 5) m^{2}. The three irrigation regimes were: i) I_1 – crop was irrigated on 30, 45 and 60 days after sowing (DAS); I_2 – Crop was irrigated at 45 and 60 DAS; I_3 – crop was irrigated at 30 and 60 DAS. Three critical growth stages like branching, peak flowering and capsule formation occured at 30, 45 and 60 days after sowing (DAS), respectively. Six levels of sub-plot treatments were: i) seeds were soaked over night (SWSON) with 100 ppm Paclobutrazol + spraying of 100 ppm Paclobutrazol @ 5 l plot^{-1} at 45 DAS; ii) SWSON with 200 ppm Paclobutrazol + spraying of 200 ppm Paclobutrazol @ 5 l plot^{-1} plot at 45 DAS; iii) SWSON with 100 ppm Cycocel + spraying of 100 ppm Cycocel @ 5 l plot^{-1} at 45 DAS; iv) SWSON with 200 ppm Cycocel + spraying of 200 ppm Cycocel @ l plot^{-1} at 45 DAS; v) SWSON with water and vi) Dry seeds were sown, i.e., control. Sesame (cv. Tilottama) was raised as the test crop. Yield components, seed and stover yields were recorded at the time of harvest.

RESULTS AND DISCUSSION

Number of capsules per plant

Skipping irrigation either at the branching (I_2) or at the flowering (I_3) stage reduced number of capsules plant^{-1} and the extension of reduction were 16.4 and 15.6 %, respectively, over non-stressed (I_1) situation (Table 1). The study showed that skipping irrigation at branching stage (I_2) had slightly greater impact on reduction in capsule number plant^{-1}. Moisture stress either reduced the canopy structure or number of flowers, as a result number of total capsule plant^{-1} decreased. Irrespective of irrigation frequency, a significant increase in capsule number plant^{-1} was observed under both the growth regulators. Highest number of capsules was recorded under both the concentrations of Cycocel. Saini *et al*. (1987) opined alike.

Number of seeds per capsule

Under non-water stressed condition, number of seeds capsule^{-1} was maximum (Table 2) and was 15.1 % higher than I_3 regime. Unlike number of capsule plant^{-1} only 6.8 % reduction of seeds capsule^{-1} was recorded when irrigation was skipped at branching stage, i.e., under I_2 regime. Under non-water stress condition application of growth regulators did not show any significant variation towards the number of seeds. Under non-stress condition the water pathway in soil - plant - atmosphere - continuum remain unaffected and due to that photosynthesis process was at its normal rate (Hillel, 1998). This is the reason for insignificant role of the growth regulator under I_1 regime. However under water-stressed condition, application of growth regulators at higher (200 ppm.) concentration recorded a significant enhancement in number of seeds and the growth regulator enhanced the photosynthetic activities of the plant.

Test weight of seeds

The test weight (1000 seeds) attained the highest value (2.69 g) under I_1 regime but the variation in test weight was nominal (0.74 to 1.12%) in comparison with I_2 and I_3 regimes (Table 3). Ravishankar *et al.* (1990) observed similar trend on seed weight for sunflower against different irrigation regimes.Irrespective of soil water status application of growth regulators increased the test weight. Interestingly it was observed that seed weight under Cycocel was significantly higher than under Paclobutrazol. Li *et al*. (1993) also observed that spraying of Paclobutrazol at the onset of flowering of soybean increased 100-seed weight of the crop.

Seed yield

Non-water stress situation encourage root proliferation and nutrient uptake (Sarkar 2005), which might be the cause in obtaining the highest (868 kg ha^{-1}) seed yield of the crop under I_1 regime (Table 4). Imposition of water stress under I_2 and I_3 regimes recorded in a decrease in yield by 17.1 and 24.3%, respectively. Results showed that application of growth regulators had compensated the yield loss due to water stressed situation in the root zone. On average, application of Paclobutrazol increased seed yield by 16 to 25% over control. The increase was to the tune of 28 to 37% when Cycocel was applied to the crop. In a field study on green gram Mandal *et al*. (1997) also observed higher seed yield when Paclobutrazol was applied to the crop.

Stover yield

Unlike seed yield, irrigation regimes influenced the variation in stover yield to a less extent. Under I_2 and I_3 regimes, where crop was under water stress 5.8 and 8.3 % decreased stover yield, respectively over the non-stressed condition (Table 5). Impact of water stress was on stover yield was 191 – 195% less than its impact on seed yield. Like irrigation regimes, growth regulators also influenced to a lesser extent to the variation on stover yield. Irrespective of soil water status highest yield was recorded under Cycocel.

Present study showed that skipping irrigation either at branching or flowering stage significantly reduced yield components and yield of sesame. Irrigation at flowering stage played more important role on crop parameters. Use of growth regulators compensated the ill effect of soil water stress on the performance of sesame. Cycocel had more impact on crop than Paclobutrazol. Concentration variation of growth regulators had no significant effect on sesame crop.

Table 1 Effect of growth regulators on number of capsules plant^{-1} at 60 days after sowing under different irrigation regimes (mean of two years)

Growth regulators (G)	Irrigation was given at		
	30, 45 and 60 DAS (I_1)	45 and 60 DAS (I_2)	30 and 60 DAS (I_3)
$Paclobutrazol_{100}$	26	22	22
$Paclobutrazol_{200}$	27	23	23
$Cycocel_{100}$	27	24	24
$Cycocel_{200}$	27	24	24
Water soaked	23	20	20
Control	24	19	20
CD (P = 0.05)	I = 3	G = 2	I x G = 2

Table 2 Effect of growth regulators on number of seeds capsule^{-1} under different irrigation regimes (mean of two years)

Growth regulators	Irrigation was given at		
	30, 45 and 60 DAS (I_1)	45 and 60 DAS (I_2)	30 and 60 DAS (I_3)
$Paclobutrazol_{100}$	34	32	30
$Paclobutrazol_{200}$	35	33	31
$Cycocel_{100}$	35	33	30
$Cycocel_{200}$	35	34	31
Water soaked	34	31	29
Control	33	30	28
CD (P = 0.05)	I = 2	G = 3	I x G =N.S.

Table 3 Effect of growth regulators on test weight (g) of 1000 seeds under different irrigation regimes (mean of two years)

Growth regulators	Irrigation was given at		
	30, 45 and 60 DAS (I_1)	45 and 60 DAS (I_2)	30 and 60 DAS (I_3)
$Paclobutrazol_{100}$	2.70	2.68	2.67
$Paclobutrazol_{200}$	2.72	2.69	2.68
$Cycocel_{100}$	2.73	2.71	2.70
$Cycocel_{200}$	2.75	2.72	2.72
Water soaked	2.64	2.62	2.61
Control	2.61	2.59	2.58
CD (P = 0.05)	I = 0.2	G = 0.2	I x G =N.S.

Table 4 Effect of growth regulators on seed yield (kg ha^{-1}) under different irrigation regimes (mean of two years)

Growth regulators	Irrigation was given at		
	30, 45 and 60 DAS (I_1)	45 and 60 DAS (I_2)	30 and 60 DAS (I_3)
$Paclobutrazol_{100}$	839	730	698
$Paclobutrazol_{200}$	922	789	731
$Cycocel_{100}$	959	786	765
$Cycocel_{200}$	1014	854	808
Water soaked	746	648	601
Control	728	639	586
CD (P = 0.05)	I = 117	G = 161	I x G = 62

Table 5 Effect of growth regulators on stover yield (kg ha^{-1}) under different irrigation regimes (mean of two years)

Growth regulators	Irrigation was given at		
	30, 45 and 60 DAS (I_1)	45 and 60 DAS (I_2)	30 and 60 DAS (I_3)
$Paclobutrazol_{100}$	2082	1954	1913
$Paclobutrazol_{200}$	2105	1996	1944
$Cycocel_{100}$	2115	2007	1973
$Cycocel_{200}$	2133	2042	1988
Water soaked	1955	1896	1845
Control	1910	1882	1836
CD (P = 0.05)	I = 135	G = 105	I x G =18

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