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Effect of Irrigation Strees at Different Critical Growth Stages on Growth, Yield and Quality of Soybean

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ABSTRACT: *The experiment was carried out at Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar (M.S.) during Kharif season, 2014 to identify the critical growth stages in soybean and workout the WUE of soybean crop. The treatment of no stress at any critical growth stage found more suitable to obtain significantly maximum growth, yield attributes and grain yield of soybean (20.70 q ha^{-1}) followed by stress at vegetative stage (16.93qha^{-1}). The stress at all critical growth stages recorded significantly minimum growth, yield attributes and grain yield of soybean (0.67 q ha^{1}) as compared to different treatments. Highest WUE was observed in treatment where stress was given at vegetative and pod development stages (88.71 kg ha^{-1}cm)followed by stress at vegetative stage (86.84 kg ha^{-1}cm) and lowest where stress was given at all stages (10.31 kg ha^{-1} cm).*

Keywords: *Soybean, Stress, Grain yield.*

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is one of the important oilseed crop grown in the temperate and tropical climate. It ranks first in respect of area and production in the world. The crop being pulse and oilseed plays three dimensional roles as a pulse, oilseed and legume. Being legume, it helps for improving soil fertility. Therefore, it has got importance in the rotation of crops. India is the third largest oilseed producer in the world. Even then the production of oilseed in the country remained stagnant during the last two decades.As soybean is mainly grown in *Kharif* season in the Maharashtra state, it is mainly affected by water stress due to drought. This experiment may help soybean growing farmers which have one or two protective irrigations with them. They would decide at what proper critical growth stage the irrigation should be provided so that they will get optimum yield.

MATERIALS AND METHODS

The experiment was carried out at Pulses Improvement Project, MPKV, Rahuri during *kharif* season, 2014. The rainout shelter was erected with position changing adjustment by using electric motor. It protects about 20 m × 60 m area from rain at a time. Experimental plots were covered whenever raining was occurred and plots left uncovered when weather is clear.Thephysical properties of soil *viz.*, field capacity, permanent wilting point and bulk density were 36.84%, 18.17% and 1.29 g cm^{-3}, respectively. The soil chemical properties such as pH, EC and organic carbon content were 8.1, 0.62 dSm^{-1} at 25°C and 0.57%, respectively. The experiment plot having moderate in available nitrogen (147.8 kg ha^{-1}), low in available phosphorous (9.6 kg ha^{-1}) and very high in available potassium (436.8 kg ha^{-1}). The experimental field was laid out in twenty four unit plots with gross plot size 2.0 m × 1.8 m and net plot 1.8 m × 1.6 m as per the plan of layout of the experimental plot.

The experiment consists of eight treatments of irrigation stress at different growth stages of soybean variety Phule Agrani (KDS-344). The treatments were replicated thrice in randomized block design.The seeds were treated with *Rhizobium* culture @ 250 g per 10 kg of seeds before sowing. Fertilizers were applied as a basal dose as per the treatments where nitrogen and phosphorus were applied uniformity in the form of urea and single

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Table 1
Growth and yield attributes of soybean as influenced by different treatments.

	Growth attributes			*Yield attributes*		*Yield (q ha^{-1})*		*Irrigation studies*
Treatment	*Plant height (cm)*	*Number of branches per plant*	*No. of nodules per plant*	*Weight of pods plant^{-1}(g)*	*Seed weight plant^{-1}(g)*	*Seed yield*	*Straw yield*	*Water use efficiency (kg ha^{-1}cm)*
I_1-No stress	65.27	6.62	11.27	18.10	28.10	20.70	23.76	79.62
I_2-Stress at vegetative stage	50.70	6.15	8.07	8.27	14.17	16.93	22.38	86.84
I_3- Stress at flower initiation stage	56.50	5.88	10.60	6.43	8.73	14.27	22.35	73.16
I_4- Stress at pod initiation stage	63.77	5.82	11.10	6.30	8.93	15.23	22.53	78.12
I_5- Stress at vegetative and flowering stage	46.60	5.74	7.77	5.73	6.60	9.73	21.72	71.33
I_6-Stress at vegetative and pod initiation stages	48.37	5.14	7.73	6.23	7.33	11.53	14.81	88.71
I_7- Stress at flowering and pod initiation stages	54.37	5.48	11.17	3.27	2.80	2.93	13.38	22.56
I_8- Stress at all the stages	45.03	5.41	7.50	1.40	2.30	0.67	10.78	10.31
SE (m±)	0.38	0.12	0.23	0.13	0.13	0.14	0.09	
CD at 5%	1.16	0.36	0.69	0.38	0.37	0.43	0.27	
General Mean	53.83	5.78	9.40	6.97	9.87	11.50	18.96	

super phosphate by band placement method just before dibbling of soybean. The dibbling of seeds was done at a spacing of 30 cm x 10 cm.Thinning was carried out at 10 DAS keeping only one healthy seedling per hill. To control the weeds in the experimental plots, one hand weeding was done at one month after sowing. First irrigation was given immediately after sowing for proper germination and respective irrigation was applied as per treatments.

RESULTS AND DISCUSSION

Growth Attributes

It could be seenfrom the Table 1. Among the treatment, no stress treatment exhibited significantly higher growth attributes *viz.*, Plant height (65.27 cm), No of branchesplant^{-1}(6.62) andNo of root nodulesplant^{-1} at 50% flowering (11.27) and followed by stress at vegetative stage, stress at pod initiation stage in respect of plant height, no of branchesplant^{-1} and no of root nodulesplant^{-1} at 50% flowering.This might be due to application of three irrigations in soil at most critical growth stages of crop resulted in development of congenial soil moisture status helped in more uptake of nutrients and favorably influence growth attributing characters. The treatment of stress at all critical growth stages registered significantly minimum growth attributes *viz.*, Plant height (45.03 cm), No of branchesplant^{-1} (5.41) and No of root nodulesplant^{-1} at 50% flowering (7.50) than all other treatment.These results are in confirmity with Brady *et.al.* (1974), Bachchhav (1990), Saxena *et.at.* (1990) and Ahmadi and Bahrani (2009).

Yield Studies

It could be seen from the Table 2. Among the treatment, no stress treatment exhibited significantly higher yield attributes *viz.*, weight of pods plant^{-1} (18.10 g), seed weight plant^{-1} (28.10 g), straw yield (23.76 q ha^{-1}) and seed yield (20.70 q ha^{-1}) and followed by stress at vegetative stage, stress at pod initiation stage in respect of weight of pods plant^{-1}, seed weight plant^{-1}, straw yield and seed yield. This might be due to better soil moisture availability throughout the growth period of soybean. The treatment of stress at all critical growth stages registered significantly minimum yield attributes *viz.*, weight of pods plant^{-1} (1.40 g), seed weight plant^{-1} (2.30 g), straw yield (10.78 q ha^{-1}) and seed yield (0.67 q ha^{-1}) than all other treatments. These results are in confirmity withStocker and Carter (1984), Brown *et.al.(*1985), Dybing*et.al.* (1986), Foroud *et.al.* (1993), Kirda *et.al.* (1994), De Souza *et.al.* (1997), Liu *et.al.* (2003) and Karam *et.al.* (2005).

Irrigation Studies

It could be seen from the Table 3. Among the treatment, no stress treatment exhibited significantly higher total consumptive use of water (350.87 mm) and followed by stress at flower initiation stage. Whereas stress at vegetative and pod initiation stages treatment exhibited significantly higher water use efficiency (88.71 kg ha^{-1}cm) and followed by stress at vegetative stage. This might be due to water use efficiency was not higher in treatment of higher seed yield but it was maximum in the treatment where water was efficiently used for yield maximization.

From the results we can discuss that stress at vegetative and pod initiation stages did not affect much to water use efficiency but stress at flowering stage considerably decreased the water use efficiency. The treatment of stress at all critical growth stages registered significantly minimum water use efficiency (10.31 kg ha^{-1}cm) than all other treatments. These results are in confirmity with English *et.al.* (1990) and Karam *et.al.* (2005).

Based on one year experimentation it could be concluded that three irrigations *viz.* first at vegetative, second at flowering and third at pod initiation stage to Phule Agrani variety of *kharif* Soybean, was found suitable to achieve maximum seed yield and monetory returns.

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