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Effect of Surface Drainage on Water Table and Performance of Soybean

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ABSTRACT

The experiment on the effect of surface drainage on water table and performance of soybean crop were conducted during *kharif* season of 1985-1991 at adopted villages of ICAR Drainage Project, JNKVV Centre-Bari (Raisen) at Barna Command region of Madhya Pradesh. The JS 72-44/JS 72-280 were taken as test varieties. The yield reduction due to 1-4 days excess soil moisture regimes were varied from 1.77 to 32.42% at crop emergence stage, 3.04 to 24.18% at branching stage and 1.49 to 15.09% at flowering stage. The surface drainage system have been found effective in controlling the surface stagnation as well as sub-surface water by 17 cm at Bari, 96 cm at Patni and 18 cm at Babai village after 5 years construction of drainage system. The impact of surface drainage system on average yield increment of soybean was observed 3.41 q/ha at Bari 2.54 q/ha at Babai and 2.45 q/ha at Patni village. The yield of soybean was increased by 22.7% at Patni, 27.4% at Babai and 31/8% at Bari village after 5 years of construction of surface drainage system.

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INTRODUCTION

Soybean *Glycine max* (L) Merril is a major crop of Barna Command occupying more than 30% of total culturable command in *kharif*. The problem of water-logging and drainage are ever growing in irrigated command. The presence of excess surface and sub-surface water leads to water logging which needs drainage. The yield reduction or complete crop failure is generally being observed due to excess soil water which impedes soil aeration by adversely affecting the root and shoot development. Rising trends of ground water table in Barna command has adversely affected the soybean cultivation, which inhibits the growth specially at earl stage. It may be due to heavy and frequer rains, application of irrigation water during ra season, low infiltration rates, lack of natural ou lets for safe disposal of excess water and fina ly, the presence of impervious layer below metre of soil depth (Singh *et al.* 1982). Genera ly 2-4 days surface stagnation is being ob served under field condition and yield reductio is varied from 2.38 to 35% (Anonymous 199 The rising trends of ground water table inhib the production of soybean by 25 to 33% reported by Kool and Maurya (1988). T surface drainage system have been fou effective to control the rising water tab

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trends by 11 cm to 127 cm and surface stagnation effectively in *kharif* and yield has been increased by 25 to 50% (Mal *et al.* 1985). Hence present studies were conducted to see the effect of surface drainage on rising trends of shallow ground water table and performance of soybean crop.

MATERIALS AND METHODS

The sudy was conducted on clayey soil of Barna Command at farmers field during *kharif* season of 1984 to 1991. The fileds were low in available nitrogen, phosphorus and medium to high in potash with the neutral soil reaction (pH 6.8 to 7.2), low in infiltration rates 0.9 to 1.2 cm/hour and bulk density of 1.51 g/cc. The soybean JS 72-44/JS 72-280 were taken as test variety and were planted in first week of July from 1984 to 1991. The average annual rainfall was recorded 1240 mm which is distributed from June to September. The 1-4 days maximum rainfall for the return period of 2, 5, 10 and 20 years have been estimated presented in Table 1.

TABLE 1

Maximum depth of rainfall (mm.) at Barna Command area of Madhya Pradesh.

Particulars	*Return period (years)*			
	2	*5*	*10*	*20*
Maximum 1 day rainfall (mm.)	72	110	132	158
Maximum 2 days rainfall (mm.)	118	175	205	238
Maximum 3 days rainfall (mm.)	130	188	235	258
Maximum 4 days rainfall (mm.)	157	232	255	265

The surface drainage @ 6 lit/sec./ha. were constructed at Bari, Patni and Babai village during 1986 to 1988 where water table was within the effective root zone depth. The water table fluctuation were recorded in auger hole and in open wells.

RESULTS AND DISCUSSION

Effect of excess moisture on soybean

Tha data pertaining to yield reduction of soybean under 1-4 days excess moisture condition has been depicted in Fig 1. It is evident from the data that yield reduction due to 1-4 days submergence varied from 1.77 to 32.42% at sowing to crop emergence, 3.04 to 24.18% at branching and 1.49 to 15.05% at flowering stage. The maximum yield reduction of soybean 12.06 to 32.42% have been observed under 3-4 days submergence. It may be due to adverse effect of excess moisture on soil aeration which caused more mortallity of plants. The greater mortailty due to excess soil moisture were noted at sowing to crop emergence stage. Soybean crop tolerated 1 day submergence effectively at early stage and 1-2 days submergence at later stage of the growth. The same findings were also reported by Anonymous 1991 and Mal *et al.* 1985.

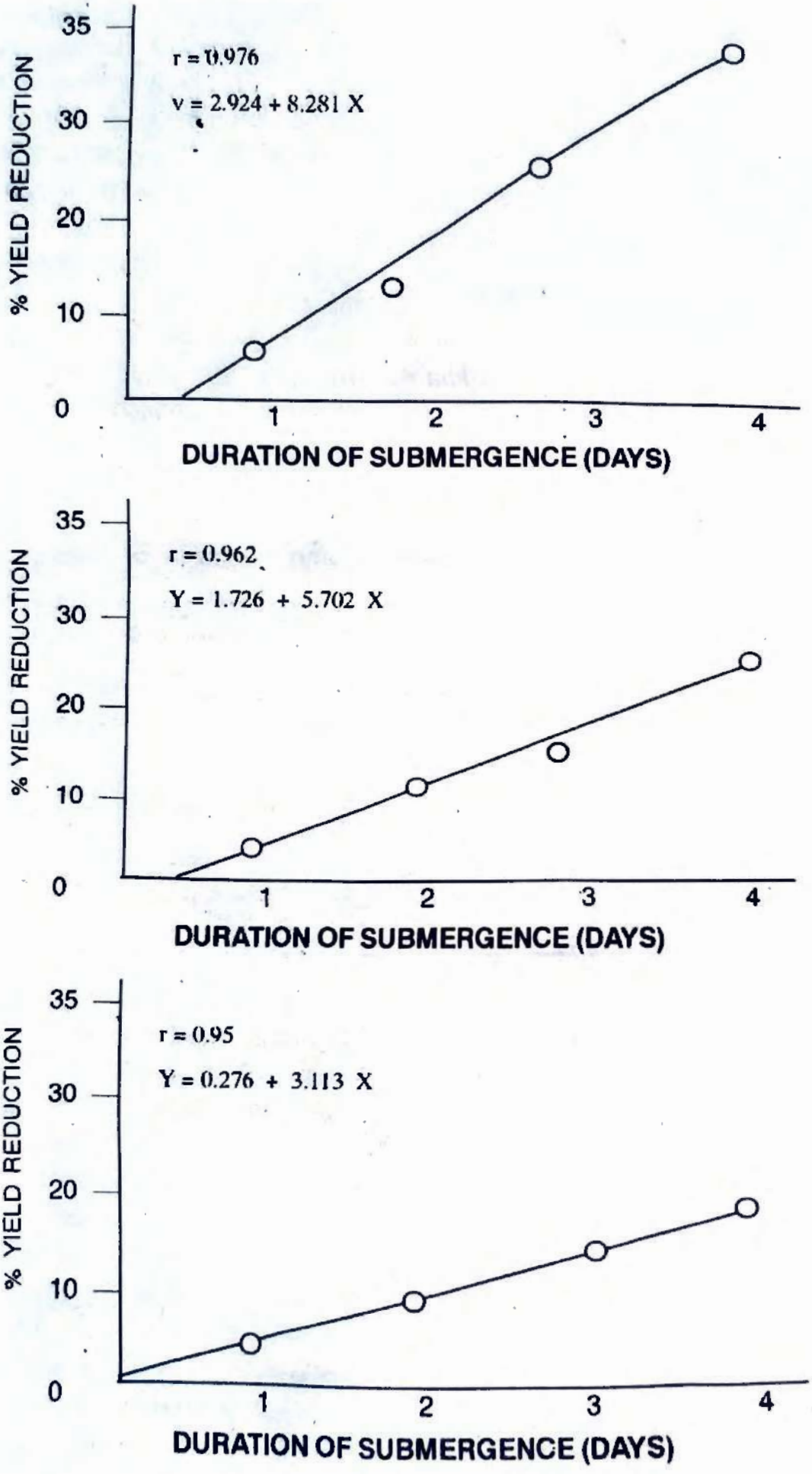


Fig. 1 : Linear relationship in different duration of submergence and yield reduction of soybean

The 1-4 days submergence and yield reduction of soybean were significantly correlated and yielded a correlation coefficient of 0.976 at sowing to crop emergence stage, 0.962 at branching and 0.953 at flowering stage and depicted in Fig. 1 alongwith the linear relationship. Finally it has been concluded that soybean crop tolerated 1 day submergence effectively and surface drainage should be designed by considering 1 day effective tolerance period.

Effect od surface drainage

Water Table : The monthly ground water table fluctuation from the ground surface before and after construction of surface drainage have been presented in Table 2. It is evident from the data that water table depth varied from 54-17(cm at Bari, 15-130 cm at Babai and 18-87 cn at Patni village before construction of surfac(drainage system during entire crop season fron June to October. The ground water table deptl was within the effective root zone depth prior tc construction of field drainage system. It may be due to concentration of more than 90% of tota rainfall from July to September month, lack of natural outlets for safe disposal of excess rain water, low infiltration rates 0.9 to 1.2 cm/hour and presence of impervious layer below 2 metre of soil depth. The existing ground water table depth was lowered by 0 to 41 cm at Bari, 11 to 23 cm at Babai and 76 to 127 cm at Patni village after 5 years construction of drainage system @ 6 lit/sec/ha.

TABLE 2

Impact of surface drainage on ground water table fluctuation from ground surface (cm).

Village	*Month*					*Seasonal mean*
	June	*July*	*August*	*Sept.*	*Oct.*	
I. Before construction of surface drainage						
Bari	170.00	64.00	54.00	66.00	75.00	86.00
Babai	130.00	58.00	15.00	39.00	62.00	61.00
Patni	87.00	40.00	20.00	18.00	23.00	37.00
Mean	129.00	54.33	29.66	41.00	53.33	61.30
II. After 5 years construction of surface drainage						
Bari	183.00	105.00	66.00	66.00	96.00	103.00
Babai	153.00	81.00	26.00	52.00	82.00	79.00
Patni	214.00	148.00	96.00	95.00	115.00	135.00
Mean	183.33	111.33	62.66	71.00	96.66	105.00
III. Impact of surface drainage on lowering of existing ground water table depth						
Bari	-13.00	-41.00	-12.00	-0.00	-21.00	-17.00
Babai	-23.00	-23.00	-11.00	-13.00	-20.00	-18.00
Patni	-127.00	-108.00	-76.00	-77.00	-92.00	-96.00
Mean	-54.33	-57.33	-33.00	-30.00	-44.33	-43.66

The seasonal mean water table depth varied from 66 to 183 cm at Bari, 26 to 153 cm at Babai and 95 to 214 cm at Patni village. It has been observed that water table depth was comparatively deeper after construction of surface drainage. The impact of surface drainage on lowering of mean ground water table depth were observed by 96 cm at Patni, 18 cm at Babai and 17 cm at Bari village after 5 years construction of surface drainage system. The same findings were reported by Kool and Maurya 1988, Sharma *et al.* 1990 and Anonymous 1991.

Yield attributes : The data pertaining to yield attributing characters have been presented in Table 3. It is clear from the data that the superior yield attributing characters were observed under drainage condition and the yield of soybean crop was comparatively higher by 33.30% at Bari, 20/.17% at Babai and 18.70% at Patni village.

TABLE 3

Yield attributing characters and yield of soybean in drained and undrained conditions.

(Pooled data)

Particulars	*Undrained condition*			*Drained condition*		
	Bari	*Babai*	*Patni*	*Bari*	*Babai*	*Patni*
Plant height (cm)	54.00	58.30	59.30	37.50	63.80	65.00
No. of branches/plant	1.50	2.00	2.00	3.50	3.00	3.00
No. of nodes/plant	12.50	8.60	12.10	13.00	14.00	12.60
No. of pod bearing nodes/plant	9.80	6.00	10.60	12.30	10.20	10.85
No. of pods/plant	32.50	28.00	37.00	43.00	36.80	47.00
Pod yield/plant (g)	18.50	16.00	17.30	24.00	20.00	18.00
Biomass/plant (g)	21.80	20.30	21.30	34.00	29.00	27.80
No. of seeds/plant	75.00	63.00	61.00	90.00	82.00	63.00
Seed yield/plant (g)	8.10	7.20	7.15	10.60	9.60	7.35
Seed yield q/ha	13.20	11.90	12.30	17.50	14.30	14.60
	(0.00)*	(0.00)*	(0.00)*	(33.30)*	(20.17)*	(18.70)*

*% Increase in yield.

Yield and yield increment : The data pertaining to yield and yield increment have been presented in Table 4. It is evident from the data that the yield of soybean crop was increased by 22.7% at Patni, 27.4% at Babai and 31.8% at Bari village. It may be due to partial improvement of drainage in soybean crop. The same findings were also reported by Anonymous 1989, Kool and Maurya 1988 and Sharma *et al.* 1990. The impact of surface drainage on yield increment of soybean crop was observed 3.41 q/ha at Bari, 2.54 q/ha at Babai and 2.45 q/ha at Patni village after 5 years construction of surface drainage system

TABLE 4

Average yield and yield increment of soybean (JS 72-44) q/ha.

Particulars	*Bari*	*Babai*	*Patni*	*Mean*
Before construction of drainage system	10.70	9.25	10.80	10.25
After 5 years construction of drainage system	14.11 (31.8)*	11.79 (27.4)*	13.25 (22.7)*	13.05 (27.3)*
Impact of drainage on yield increment	3.41	2.54	2.45	2.80

REFERENCES

Anonymous (1988 & 1991). Annual Reports. All India Coordinated Research Project on Agricultural Drainage under actual farming condition on watershed basis. JNKVV centre Bari.

Kool, Y. M. and Maurya, B. M. (1988). Performance of soybean crop as influenced by water table depths at Barna Command. *Proc. of seminars on water table management for different crops in differenct regions.* Held at WALMI Bhopal Nov., 1-3 (1988) : III 29-36.

Mal, B. C., Mishra, A. P. and Singh A. K. P. (1985). Effect of subemergence of yield of kharif maize. *Proc. ISAE, SJC held at CIAE* Bhopal 1985 Vol. 2 : III 61-66.

Sharma, R. K. Maurya, B. M. Kushwah, S. S. and Yadav R. D. (1991). Water table fluctuation and its effect on growth and heat use pattern of soybean at Barna Command. *Souv. Cum. Absta.* of *XXVII Annual convention of ISAE held at IARI, New Delhi* October 9-11 (1991) : 16-17.

Singh, O. P. and Yadav, J. S. P. (1982). Some Hydrologic aspects of Salt affected soils. *J. Indian Water Resorces Society* **2** : 25-36.