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MOISTURE STRESS MANAGEMENT IN SOYBEAN

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ABSTRACT

Field experiment was carried out at the Agricultural College and Research Institute, Madurai for two years (1990, 1991 during summer season to study the effect of moisture stress on soybean in terms of growth and yield and to quantify the stress effect on different growth stages of soybean. The results revealed that peak flowering stage was found to be the most sensitive stage for moisture stress resulting in a yield loss accounting to 13.0 and 20.7 per cent in 90 and 91 respectively. Of the stress alleviating materials, kaolin at 3% as foliar spray or liquid paraffin at 1% foliar spray could be used to mitigate the stress effect.

KEY WORDS : Irrigation régimes, moisture conservation, physiological stages, kaolin, liquid paraffin, Jalsakthi

Soybean is a potentail pulse-cum-oilseed crop (two-in-one crop) supplying about 42% protein and 20% oil. But unfortunately the productivity of soybean happens to be abysmally low (Reddy, 1985). While the potentail yield happens to be 11.0 $t.ha^{-1}$ (Johnson, 1982) the average productivty accounts to be only 0.85 $t.ha^{-1}$ in our country, warranting greater research requirements on soybean. Non availability of quality seeds, inadequate fertilizations, and lack of management practices are some of the prime constraints for the low yield. Among the management practices, optimum moisture environment at the root zone of the crop is the most important which could be possible through supply of irrigation water at right quantity and at right time because moisture stress or excessive water would affect the plant growth, and yield of soybean (Griffin and Saxton, 1988).

Irrigation can be skipped at certain growth stage of the crop without affecting the yield by resorting to certain management practices. Results on crops like cotton, and soybean revealed that the use of kaolin as transpiration suppressant was found to be effective in reducing the evapotranspiration of the crop. Keeping these in view, field experiments were carried out on soybean var. CO1 to study the effect of moisture stress at different growth stages and to quantify in terms of growth, yield and water use efficiency.

MATERIALS AND METHODS

Field experiments were conducted at the Agricultural College and Research Institute, Madurai during summer season in 1990 and 1991. The soil of the experimental field in both the years was of sandy clay loam with low in available N and medium in available P and high in available K. The experiment was carried out in a split plot design. The main plot treatments comprised of the stress imposement during the following physiological stage *viz.*,

S1	moisture stress during pre-flowering stage (11-30 days after sowing - DAS):
S2	peak flowering stage (31-50 DAS):
S3	pod development stage (51-70 DAS); and
S4	pod maturity stage (71-90 DAS).

The sub-plot treatments comprised of the use of the following stress alleviating materials:

M1	Control
M2	Kaolin at 3% foliar spray in 1990 and activated clay in 1991.
M3	Liquid paraffin at 1% foliar spray.
M4	Jalsakthi-soil application at 10 kg ha^{-1} in 1990 and seed treatment at 15 g/kg of seed in 1991.

All the treatment combinations were replicated three times. Soybean var. Co1 was sown on 5 January 1990 and 18 February 1991 and harvested on 10 April 1990 and 22 May 1991 for the I and II year respectively. Biometric observatrions on plant height, pod number per plant, 100 seed weight and seed yield were recorded.

RESULTS AND DISCUSSION

Plant height

Plant height was recorded at three growth stages during 30 and 60 days after sowing (DAS) and at maturity stage in both the years of experimentation (Table 1). The results indicated similar trend in 1990 and 1991. Moisture stress imposed during pre-flowering stage (11-30 DAS) had significantly affected the plant height as compared to stress imposed during other stages. The same trend was observed where plant height was recorded at 60 DAS. However, it was severly affected at maturity stage owing to the stress experienced at peak flowering stage, which might be due to the decreased photosynthetic and transpiration rates as reported by Singaram (1990). Thus, it is evident that moisture stress during preflowering and peak flowering stages were critical to affect the plant height as compared to stress at pod formation and pod maturity stages.

Regarding stress alleviating treatments, it was evident that during 1990 the effect of liquid paraffin at 1% foliar spray and soil application of Jalsakthi at 10 Kg ha^{-1} were comparable in mitigating the stress imposed during early growth stage (30 DAS); whereas the liquid paraffin showed supremacy in increasing plant height on 60 DAS and at maturity stages. followed by kaolin at 3% foliar spray at maturity stage. Thus, it is evident that moisuture stress could be mitigated by application of either kaolin at 3% foliar spray or liquid paraffin at 1% foliar spray.

Yield attributes

The data revealed that moisture stress during peak flowering stages had drastically reduced the pod number per plant (43.0 and 41.6 in 90 and 91 respectively) followed by stress at preflowering stage, recording 45.8 and 44.3 pods per plant in 1990 and 1991 respectively (Table 2). However, stress at pod maturity stage did not affect the pod production (52.7 and 51.1 pods/plant in 1990 and 1991 respectively). Regarding 100 grain weight, moisture stress at peak flowsering, pod formation and pod maturity, stages were found to be critical producing lesser weight compared to stress during

Table 1. Plant height (cm) of soybean as influenced by treatments

Treatment		1990 Summer			1991 Summer		
		Preflowering 30 DAS	Pod development (60 DAS)	Pod maturity	Preflowering 30 DAS	Pod development (60 DAS)	Pod maturity
Moisture stress at							
Pre flowering	(S_1)	47.6	59.6	82.2	49.6	69.2	83.4
Peak flowering	(S_2)	57.2	66.8	81.4	49.5	67.4	80.4
Pod formation	(S_3)	57.6	79.0	85.4	61.5	85.2	86.8
Pod maturity	(S_4)	50.2	74.3	86.0	64.5	86.1	89.5
SE_D		0.4	0.6	1.1	1.2	2.0	1.3
CD at 5%		1.0	1.5	2.8	2.9	4.9	3.1
Stress Management							
Practices Control	(M_0)	52.2	62.7	70.7	47.6	69.4	74.3
Kaolin ('90) Activated Clay (1991 at 3% foliar spray	(M_1)	54.0	70.1	80.3	61.1	74.3	82.5
Liquid paraffin at 1% foliar spray	(M_2)	56.6	74.4	87.3	59.8	78.9	86.0
Jalsakthi at 10 kg ha^{-1} soil application ('90) 15 g. kg^{-1} of seed ('91)	(M_3)	56.9	66.4	78.2	56.6	70.1	78.4
SE_D		0.6	0.6	0.8	1.7	2.0	1.8
CD at 5%		1.4	1.4	1.9	3.5	4.0	3.7

DAS : Days after sowing

Table 2. Yield and yield attributes of soybean as influenced by treatments

Treatment		Yield attributes					
		No.of pods/plant		100 seed weight (g)		Grain yield (kg ha^{-1})	
		1990	1991	1990	1991	1990	1991
Moisture stress at							
Preflowering	(S_1)	45.8	44.3	11.5	11.3	2290	2184
Peak flowering	(S_2)	43.0	41.6	10.8	10.7	2099	1865
Pod formation	(S_3)	48.7	47.5	10.9	10.7	2414	2270
Pod maturity	(S_4)	52.7	51.1	11.3	10.9	2399	2351
SE_D		1.6	1.8	0.2	0.2	95	55
CD at 5%		3.9	4.4	0.5	0.5	232	134
Stress Management							
Practices Control	(M_0)	42.4	41.9	10.9	10.7	2147	1988
Kaolin ('90) Activated Clay		51.2	49.7	11.6	11.4	2395	2388
(1991 at 3% foliar spray	(M_1)						
Liquid paraffin at 1%							
foliar spray	(M_2)	49.4	48.0	10.9	10.9	2324	2297
Jalsakthi at 10 kg ha^{-1} soil							
application ('90)		45.6	44.8	11.1	10.9	2345	2068
15 g. kg^{-1} of seed ('91)	(M_3)						
SE_D		1.8	1.5	0.3	0.2	79	42
CD at 5%	3.7	3.1	0.6	0.4	163	87	

pre-flowering stage. Foliar spray with either kaolin at 3% or liquid paraffin at 1% foliar spray exhibited the same effect on number of pods/plant;however, significant difference was observed in 100 grain weight with kaolin spray, compared to all other treatments. Kaolin at 3% foliar spray had profound influence on pod number and seed weight as compared to control plots. The same results were exhibited in both the years.

Seed yield

Soybean seed yield, recorded in both the years of experiments (Table 2) revealed that peak flowering stage was the most critical stage for moisture stress as evidenced from the lowest seed yield of 2099 and 1865 kg ha^{-1}, respectively in 1990 and 1991, followed by stress at preflowering stage. However, stress at pod formation and pod maturity stages did not affect the seed yield adversely. This is also in confirmation with the finding of (Cassel *et al.*, 1978) who had reported that soil water stress during bloom and pod filling stages resulted greater reduction in grain yield.

With regard to use of stress alleviating materials, kaolin at 3% foliar spray registered higher seed yield of 2395 kg, ha^{-1} during 1990, but it was on par with foliar spray of 1% liquid paraffin and soil application of Jalsakthi at 10 kg ha^{-1}. During 1991, the seed yield recorded under the treatment of activated clay foliar spray (2283 kg ha^{-1}) and liquid paraffin foliar spray (2297 kg ha^{-1}) were comparable, however it was significantly higher than Jalsakthi seed treatment at 15 g/kg of seed (2068 kg ha^{-1}) and control (1988 kg ha^{-1}). This indicated that either kaolin at 3% or liquid paraffin at 1% as foliar spray can be used as moisture stress alleviating materils during periods of water scarcity. Radhakrishnan *et al.;* (1985) also recorded 12% increased yield in soybean due to kaolin at 3% foliar spray.

Thus, it is evident that moisture stress during pod development and pod maturity did not adversely affect the seed yield of soybean. The yield loss due to the moisture stress during peak flowering or preflowering stage could be compensated by foliar spraying with either 3% kaolin/activated clay or 1% liquid paraffin.

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ECONOMIC EFFICIENCY OF COMPONENT LINKAGE IN LOWLAND INTEGRATED FARMING SYSTEM

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ABSTRACT

Field experiments were conducted at the Department of Agronomy, Tamil Nadu Agriculturan University, Coimbatore to identify the best mix of components from among poultry, pigeon, fish, mushroom enterprises with cropping as base activity in comparison with cropping alone under marginal lowland farming condition for two years (1993-94, 1994-95). The economics of integrated farming systems was analysed interms of gross and net returns, returns per day and benefit cost ratio for the different combinations of components integrated in this programme. Results indicated that crop + pigeon + fish + mushroom integration was found to be superior in obtaining the highest net return to the tune of Rs. 90,252 ha^{-1} $year^{-1}$ with higher per day return and benefit cost ratio of 2.44 in marginal lowland farming situation.

KEY WORDS : Integrated farming system, marginal lowland, returns, benefit cost ratio

Compounding the problem arising from the growing pressure of human population on the carrying capacity of the land and the productivity, the agricultural systems have encountered with various kinds of ecological and environmental problems. The ultimate goal of sustainable agriculture is to conserve the natural resource base, protect the environment, enhance the health and safety of human population over a longer period. This can be achieved by seeking the optimal use of internal production inputs in a way that provide acceptable levels of sustainable crop productity and livestock production resulting in economically profitable return. With a view to mitigate the risks and uncertainties of income from crop enterprises and to reduce the time lag between investment and returns, it is essential that the farmers include such of those enterprises in their production programme that yield regular and evenly distributed income throughout the year (Throve and Galgolikar, (1985).

More than 80 million farm holdings in India are below the size of 1.00 ha leaving no scope for expanding the individual farm size because of steady explosion of population with shrinkage of cultivated land due to urbanisation and industrialization (Mahapatra and Bapat, 1992). Therefore, the vertical expansion of agricultural production alone is possible by integrated appropriate farming components requiring lesser space and time and ensuring periodic income to the farmer. For assured regular income and decent living the farmer has to think of other allied enterprises with better complementarity to cropping activity. This is made possible through optimal crop and livestock mix, consistent with the farm resources immediately available. Hence, the present integrated farming system research was carried out to evolve an economically viable and sustainable farming system component integration for marginal lowland farming situations.