International Archive of Applied Sciences and Technology
Int. Arch. App. Sci. Technol; Vol 10 [4] December 2019 : 175-179
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[ISO9001: 2008 Certified Organization]
www.soeagra.com/iaast.html

IAAST
ONLINE ISSN 2277- 1565
PRINT ISSN 0976 - 4828

CODEN: IAASCA ORIGINAL ARTICLE

DOI: .10.15515/iaast.0976-4828.10.4.175179

Effect of Yield Attributes and Economics Of Soybean As Influenced By Fertigation On Different Growth Stages

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ABSTRACT
The Productivity and economics of soybean as influenced by fertigation on different growth stages was carried out during Kharif season of 2016 at the Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyala, Raipur. Raipur situated at latitude of 21^{0}4' N longitude of 81^{0}35 'E and altitude of 290.20 m above mean sea level.The experiment was laid out in randomized block design (RBD) with three replications. The treatment comprised nutrient combination of50% RDF as basal + 50% RDF through Fertigaion at flowering, 50% RDF as basal+50% RDF through Fertigaion at pod initiation,50% RDF as basal+50% RDF through fertigation at grain filling,100% RDF as basal+ Irrigation at flowering,100% RDF as basal +Irrigation at pod initiation,100% RDF as basal +Irrigation at grain filling and 100% RDF as basal. The results revealed that the maximum number of pods per plant, seed per plant, 100-seed weight, yield attributes, seed yield, stover yield, harvest index and economics of soybean production in terms maximum gross return (Rs. 84708 ha^{-1}), net return (Rs.64756 ha^{-1}) and benefit: cost ratio (3.25) was recorded under T_3-50% RDF as basal+50% RDF through fertigation at grain filling stage in soybean.
Keyword *- Soybean, yield attributes, fertigation, grain filling, economic.*

Received 21.07.2019 Revised 27.09.2019 Accepted 06.11.2019

CITATION OF THIS ARTICLE
A K Bhagat, P Singh, V K Tripathi and R Lakpale. Effect of Yield Attributes and Economics Of Soybean As Influenced By Fertigation On Different Growth Stages. Int. Arch. App. Sci. Technol; Vol 10 [4] December 2019 :168-171

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] known as a wonder crop of 20th century because it contains about 40-42% high quality protein, 20-22% edible oil, 20-30% carbohydrates, 4.5% minerals, 3.7% fibre, 8.1% water, large amount of phosphorus, high level of amino acids such as Lysine, Leucine, Lecithin and century because it vitamins. It is a food that is as nearly perfect as cow's milk, meat, and eggs and at the same time rich in iron and vitamin C. Hence, it is well established fact that soybean is a cheap source of protein and edible oil. It is builds up the soil fertility by fixing atmospheric nitrogen through the root nodules, and also through leaf fall on the ground on maturity. It is able to leave residual nitrogen effect for succeeding crop equivalent to 35-40 kg N ha^{-1}. It can tolerate mild drought as well as floods. This characteristic has made soybean to fit well in sustainable agriculture. Soybean due to its various uses is rightly called "Golden Gift" of nature to mankind.

Fertigation is a modern agro technique combining water and fertilizer application through irrigation provides an excellent opportunity to both maximize yield and minimize environmental pollution [3]. Drip irrigation is probably the most effective method of water application.It is the most advance and efficient practice of fertilization. The water and nutrients, the two precious resource and important factors in plant growth are combined through fertigation. It ensures application of the fertilizers directly to the plant roots. In

fertigation, fertilizer application is made in small and frequent doses that fit within scheduled irrigation intervals matching the plant water use to avoid leaching. Fertilizer use efficiency up to 95% can be achieved through drip fertigation. Studies revealed significant fertilizer savings of 20-60% and 8-41% increase inyields of horticulture and vegetable crops due to fertigation [6].

MATERIAL AND METHODS

The Productivity and economics of soybean as influenced by fertigation on different growth stages was carried out during *Kharif* season of 2016 at the Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyala, Raipur. The experiment was laid out in randomized block design (RBD) with three replications. The treatment comprised nutrient combination of**T_1**-50% RDF as basal + 50% RDF through Fertigaion at flowering, **T_2**-50% RDF as basal + 50% RDF through Fertigaion at pod initiation,**T_3**-50% RDF as basal + 50% RDF through fertigation at grain filling,**T_4**-100% RDF as basal + Irrigation at flowering,**T_5**-100% RDF as basal + Irrigation at pod initiation,**T_6**-100% RDF as basal + Irrigation at grain filling and **T_7**-100% RDF as basal. The soil of the experimental field was clayey in texture (*Vertisols*) with low N, medium P_2O_5 and high K_2O content. Management practices for soybean done as per recommendation. Cost of production for all treatments was worked out on the basis of the prevailing market price of input and the produce. The net return ha^{-1} was calculated by subtraction the cost of production ha^{-1} from the gross return ha^{-1}ultimately, net return $rupee^{-1}$ invested was calculated treatment wise to assess the economic impact of the treatments by dividing the net return $ha^{-1}$with the cost of production ha^{-1}.

RESULT AND DISCUSSION

Yield and yield attributes characters of soybean influence by fertigation

Number of pod $plant^{-1}$

The data on number of pods per plant have been presented in Table 1, the maximum number of pods recorded under the treatments T_3 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at grain filling (72.5),which was found at par withT_4 - 100% recommended dose of fertilizer as basal + irrigation at flowering (71.5),T_6 - 100% recommended dose of fertilizer as basal + irrigation at grain filling (70.3),and the minimum pods per plant was recorded under the treatments T_2 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at pod initiation (65.8).Higher number of pods per plant obtained with fertigation treatments may be because of better growth, higher photosynthetic-surface area. Ganapathy and Vaitayanathan [2] also reported that N fertigation recorded higher groundnut pod yield than conventional method of fertilizer application. Increasing pod production on N fertigation (150 kg Nha^{-1}) applied to determinate (MI) and indeterminate (MD) soybeans at the end of the vegetative phase (or 8 fully expanded leaves) and during the early stages of reproductive growth (R2 and R2.5 for MI and MD, resp.) was observed by Tancogne *et al.* [8].

Number of seeds pod^{-1}

The data on number of seeds perpod have been presented in Table1, the maximum number of seeds perpod recorded under the treatmentsT_3 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at grain filling (2.85),and the minimum number of pods $plant^{-1}$ was recorded under the treatments T_7 - 100% recommended dose of fertilizer as basal (2.44).Malik *et al.* (1994) also observed that number of seeds pod^{-1} response to fertilizer application was higher with fertigation through drip irrigation than conventional method of application in pea.

Number of seeds $plant^{-1}$

The data on number of seeds perplant have been presented in Table 1, which revealed thatT_3 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at grain filling (192.47), gave significantly higher number of seeds perplant which was found at par withT_6 - 100% recommended dose of fertilizer as basal + irrigation at grain filling (184.07),T_1 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at flowering (184), and the lowest number of seeds perplant recorded under T_7 - 100% recommended dose of fertilizer as basal

(161.53), as a compared to other treatments. Higher number of seeds perplant obtained with fertigation treatments may be because of better growth, higher photosynthetic-surface area which will enhance source and sink relationship between plant dry matter and seeds.

100 seed weight (g)

The weight of 100-seed is also an important attribute of yield. The effect of fertigation practices on 100-seed weight is presented in Table 1. The data clearly revealed that there were no significant differences in weight of 100-seed due to different fertigation treatments.

Seed yield (kg ha^{-1})

The maximum seed yield was obtained under treatment T_3 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at grain filling (2667 kg ha^{-1}), which was found at par with T_1 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at flowering (2513 kg ha^{-1}), and T_6 - 100% recommended dose of fertilizer as basal + irrigation at grain filling (2513 kg ha^{-1}), and the lowest seed yield was observed under T_7 - 100% recommended dose of fertilizer as basal (2354 kg ha^{-1}). It might be due to higher growth and yield attributes observed in the same treatment (Table 1).Patil *et al.* [5] found that application of recommended dose of NPK through fertigation recorded higher cotton yield as compared to soil application of fertilizers at Dharwad in Karnataka, Sripunitha *et al.* [7] also similar result found that the sowing in ridges and furrows with subsurface drip irrigation at 100% potential evapo-transpiration led to a greater seed yield with higher seed quality of groundnut.

Stover yield (kg ha^{-1})

The data on stover yield have been presented in Table 1. The data clearly revealed that fertigation had a significant effect on the stover yield of soybean crop.

The maximum stover yield was obtained under treatmentT_3- 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at grain filling (3139 kg ha^{-1}), which was found at par with T_1 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at flowering (2943 kg ha^{-1}),and the minimum stover yield was recorded under the treatments T_7 - 100% recommended dose of fertilizer as basal (2696 kg ha^{-1}).It might be due to higher growth attributes observed in the same treatment.

Harvest index (%)

The data on harvest index have been presented in Table 1. There were non-significant difference in harvest index of soybean was found. But the highest harvest index (46.61%) obtained under treatment T_7 - 100% recommended dose of fertilizer as basal.

Rainfall use efficiency (RUE)

The data of various treatments with respect to rainfall use efficiency (RUE) in present investigation was presented in Table 1.

A careful examination of data indicates that significantly higher value of rainfall use efficiency was recorded under the treatments T_3 where 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at grain filling (2.22%),however it was found at par with T_1 application of 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at flowering (2.09%) and T_6 application of 100% recommended dose of fertilizer as basal + Irrigation at grain filling (2.09%), this may be due to higher seed yield under these treatments. This might be due to fact that different fertigation treatments help to absorb nutrients in rational way resulted production of healthy plant, which have capacity to utilize available moisture from rains is optimum quantity.

Economics of soybean influence by fertigation:

To examine the economic feasibility and viability of different treatment under investigation, economics of soybean production in terms of gross return, net return and benefit : cost ratio were calculated for different treatments on soybean. The results revealed that the maximum gross return (Rs. 84708 ha^{-1}), net return(Rs. 64756 ha^{-1}) and benefit: cost ratio (3.25) was recorded under application of 50% recommended dose of fertilizer as basal+50% recommended dose of fertilizer through fertigation at grain filling in soybean. The increase in gross and net return is obviously due to higher seed yield. Less input cost and higher economical yield might be resultant in increase the B: C ratio. Whereas, minimum gross return (Rs. 75060 ha^{-1}), net return (Rs.55108 ha^{-1}) and benefit: cost ratio (2.76) was obtained

under treatment of50% recommended dose of fertilizer as basal+50% recommended dose of fertilizer through fertigation at pod initiation in soybean. Fanish *et al.* [1] noticed that higher net returns (Rs. 56,858 ha^{-1}) and B: C ratios (3.24) were obtained under drip fertigation with 150% recommended dose of fertilizer in maize. Vijaykumar [9] reported the growth, yield attributes and yield of rice was higher under fertigation of 100% RDF through WSF, net returns and benefit cost ratio were comparatively lower than drip irrigation at 150% PE with drip fertigation of 75% RDF through WSF (Rs.30,860 ha^{-1} and 1.95 respectively) due to higher cost of water soluble fertilizers.

Table 1: Yield attributing characters of soybean as affected by different treatments of fertigation

Treatment	Pods plant^{-1}	Seeds pod^{-1}	Seeds plant^{-1}	Seeds index (g)	Seed Yield (kg ha^{-1})	Stover Yield (kg ha^{-1})	HI(%)	RUE
T_1-50% RDF as basal +50% RDF through fertigation at flowering	68.8	2.64	184	10.5	2513	2943	46.05	2.09
T_2-50% RDF as basal +50% RDF through fertigation at pod initiation	65.8	2.49	165.20	10.6	2359	2860	45.20	1.96
T_3-50% RDF as basal +50% RDF through fertigation at grain filling	72.5	2.85	192.47	10.8	2667	3139	45.94	2.22
T_4-100% RDF as basal + Irrigation at flowering	71.5	2.52	174.60	10.7	2369	2793	45.89	1.97
T_5-100% RDF as basal + Irrigation at pod initiation	68.8	2.56	179.67	10.6	2390	2865	45.46	1.99
T_6-100% RDF as basal + Irrigation at grain filling	70.3	2.63	184.07	10.5	2513	2885	46.56	2.09
T_7-100% RDF as basal	67.6	2.44	161.53	10.4	2354	2696	46.61	1.96
SE m ±	**0.73**	**0.02**	**2.76**	**0.045**	**59.35**	**66.91**	**0.497**	**0.05**
CD (P=0.05%)	**2.11**	**0.05**	**8.50**	**NS**	**184.89**	**203.5**	**NS**	**0.15**

Table 2:Economics of soybean as influenced by different treatments of fertigation

Treatment	Cost of cultivation (Rs. ha^{-1})	Gross Return (Rs. ha^{-1})	Net Return (Rs. ha^{-1})	B : C Ratio
T_1-50% RDF as basal +50% RDF through fertigation at flowering	19952	79799	59847	3.00
T_2-50% RDF as basal +50% RDF through fertigation at pod initiation	19952	75060	55108	2.76
T_3-50% RDF as basal +50% RDF through fertigation at grain filling	19952	84708	64756	3.25
T_4-100% RDF as basal + Irrigation at flowering	19752	75267	55515	2.81
T_5-100% RDF as basal + Irrigation at pod initiation	19752	75986	56234	2.85
T_6-100% RDF as basal + Irrigation at grain filling	19752	79712	59960	3.04
T_7-100% RDF as basal	18444	74503	56059	3.01

CONCLUSION

The maximum seed and stover yield kg ha^{-1} was obtained under treatment T_3 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at grain filling, which was found at par with T_1 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at flowering

stage and T_6 - 100% recommended dose of fertilizer as basal + irrigation at grain filling and Economics of soybean production in terms maximum gross return, net return and benefit cost (B:C) ratio was recorded under the T_3 - 50% recommended dose of fertilizer as basal + 50% recommended dose of fertilizer through fertigation at grain filling in soybean.

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