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RESEARCH PAPER

Effect of foliar spray of nutrients and growth regulators on seed yield and economics of hybrid pigeon pea [*Cajanus cajan* (L.) Millsp] seed production

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Abstract: An experiment to assess the effect of foliar spray of nutrients and growth regulators on seed yield and economics of hybrid pigeon pea [*Cajanus cajan* (L.) Millsp] seed production was conducted at Seed Farm, College of Agriculture, Vijayapur during *Kharif* 2019-2020. The treatments consisted Control, without any foliar spray (T_1), foliar spray of 1% Pulse magic (T_2), 1% 19:19:19 (T_3), 0.2% Borax (T_4), 50 ppm NAA (T_5), 1% Pulse magic+1%19:19:19 (T_6), 1% Pulse magic+0.2% Borax (T_7), 1% Pulse magic+50 ppm NAA (T_8), 1% Pulse magic+1% 19:19:19+0.2% Borax (T_9), 1% Pulse magic+ 1% 19:19:19+50 ppm NAA (T_{10}) and 1% Pulse magic+1% 19:19:19+50 ppm NAA+0.2% Borax (T_{11}). Foliar sprays were undertaken at flower initiation and pod formation stages of pigeon pea crop. The results indicated that foliar application of 1% Pulse magic + 1% 19:19:19 + 50 ppm NAA + 0.2% Borax recorded the higher hybrid pigeon pea seed yield (1499 kg/ha), higher gross return (₹ 2,06,694/ha), higher net return (₹ 1,61,159/ha) and higher B:C ratio (4.19).

Key words: Borax, Foliar spray, Pigeonpea, Pulse magic

Introduction

Pigeon pea [*Cajanus cajan* (L.) Millsp.] is one among the protein-rich legumes of semi-arid tropics predominantly cultivated under rainfed situations. It is second most important crop of pulse after chickpea. In India, the major area under pigeonpea falls around 14^0 and 28^0 N latitudes. Pigeonpea belongs to leguminosae family and native to Africa. It is most drought tolerant among all pulses. It is deep rooted, C_3 and short-day plant. It requires temperatures between 18-30°C and sandy loam to clay loam soils are well suited. Pigeonpea represents 6.22 million ha of world pulses area and 4.74 million tonnes of world's pulse production (Anon., 2018). In India pigeonpea occupied an area of 3.96 million ha with production of 2.56 million tonnes. Pigeonpea is cultivated in larger part of the states such as Maharashtra, Uttar Pradesh, Madhya Pradesh, Karnataka, Gujarat, Andhra Pradesh and Tamil Nadu, which together hold 87.89 per cent area and 86.10 per cent production. In recent years the area under pigeonpea is being increasing in Northern Karnataka. The average productivity is low in this region (368 kg ha^{-1}). There are many benefits to augmenting crop dietary demands. Most of the plant nutrients are absorbed through the leaves and thus absorption is rapid. Foliar nutrition can hasten the growth of a crop at a sudden. Foliar feeding is more useful in early maturing crops like pulses, which could be combined with regular plant protection programmes. Foliar fertilizer is intended to remove issues such as fixation of nutrients and immobilization. Therefore, foliar nutrition is identified as an important fertilization strategy in present agriculture (Chaurasia *et al.*, 2005).

Yield of pigeon pea is reducing due to several reasons and one of the important reasons is because of high level of flower abscission (70-96 %), leading to a much- reduced realization of sink potential (Saxena *et al.,* 2006). Therefore, it has realized that reduced yield in pigeon pea is due to more vegetative growth, indeterminate growth habit, poor source-sink relationship, poor pod set resulting from the high flower and pod drops. So, it is necessary to compensate for the higher rate of flower abscission in pigeon pea to increase the pod yield. Quality seed production is a specialized activity that paves way for initial assurance towards realization of higher output. The general farm saved seed cannot be substituted for quality seed, as it generally lacks genetic vigour and has poor germination. It is estimated that the direct contribution of quality seed alone to the total production is about 15-20 % depending upon the crop and it can be further raised up to 40 per cent with effective management of other inputs (Govind *et al.,* 2016). Various factors influence seed yield, costs and returns in pigeon pea seed production which affect its profitability and account to different impacts on adopters of seed production as well as seed producers. Hence, this study was undertaken with an objective of enhancing the seed yield and net returns of pigeon pea seed production and its adoption among farmers .

Material and methods

The field experiment was conducted at Seed Farm, College of Agriculture, Vijayapura, during *kharif* 2019-2020. The experiment was laid out in randomised block design with 11 treatments *viz.,* Control, without any foliar spray (T_1), Foliar spray of 1% Pulse magic (T_2), 1% 19:19:19 (T_3), 0.2% Borax (T_4), 50 ppm NAA (T_5), 1% Pulse magic+1%19:19:19 (T_6), 1% Pulse magic+0.2% Borax (T_7), 1% Pulse magic+50 ppm NAA (T_8), 1% Pulse magic+1% 19:19:19+0.2% Borax (T_9), 1% Pulse magic+1% 19:19:19+50 ppm NAA (T_{10}) and 1% Pulse magic+1% 19:19:19+50 ppm NAA+0.2% Borax (T_{11}) with three replications. Foliar spray was taken up at flower initiation and peak flowering stages. The crop was cultivated by following the recommended package of practices. The seed yield was recorded from net plot from each treatment further converted into per ha, cost of

Table 1. Effect of different sources of nutrients and growth regulators on seed yield and economics of hybrid pigeonpea seed production

Treatments	Seed yield (kg/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C ratio
T_1	903	143265	100764	3.27
T_2	930	159649	113588	3.48
T_3	916	172783	127844	3.75
T_4	912	160053	153678	3.80
T_5	1013	166364	124591	3.77
T_6	1059	171943	123289	3.37
T_7	1030	176374	154247	4.07
T_8	1137	191113	144869	4.10
T_9	1266	184013	131272	4.14
T_{10}	1405	170074	121796	3.59
T_{11}	1499	206694	161159	4.19
Mean	1097	172938	132463	3.77
S.Em.±	31.3	3045.76	1955.05	0.06
C.D. at 5 %	94.56	8984.90	5767.35	0.19

Note : T_1-Control
T_2 - Pulse magic @ 1 %
T_3 - 19:19:19 @ 1 %
T_4 - Borax @ 0.2 %
T_5 - NAA @ 50 ppm
T_6 - Pulse magic @ 1 % + 19:19:19 @ 1 %
T_7 - Pulse magic @ 1 % + Borax @ 0.2 %
T_8 - Pulse magic @ 1 % + NAA 50 ppm
T_9 - Pulse magic @ 1 % + 19:19:19 @ 1 % + Borax @ 0.2 %
T_{10} - Pulse magic @ 1 % + 19:19:19 @ 1 % + NAA 50 ppm
T_{11} - Pulse magic @ 1 % + 19:19:19 @ 1 % + NAA 50 ppm + Borax @ 0.2 %

cultivation, gross returns, net returns and B:C ratio is calculated. The harvested pods along with plants from each net plot were threshed separately, winnowed, cleaned and dried under sun up to 10% moisture. The net plot seed yield was finally converted into kg/ha. The economic hybrid seed produce obtained from each plot was calculated by multiplying the yield with the prevailing seed procurement price (₹ 150 /kg) and statistically analysed by following analysis of variance method

Table 2. Prices of inputs and outputs

	Particulars	Price
A.	Inputs	
	Pigeonpea seeds	₹ 150 kg^{-1}
	Manures and fertilizers	
	a. Urea	₹ 6.0/kg
	b. DAP	₹ 25.3/kg
	c. Boran	₹ 150.0/kg
	NAA	₹ 250/L
	19: 19: 19	₹ 190/kg
	Pulse magic	₹ 240/kg
	FYM	₹ 15,000/t
	Plant protection chemicals	
	Coragen	₹ 2000/L
	Proclaim	₹ 605/L
	Deltametrin	₹ 1050/L
	Labour wages	
	Men	₹ 264/day
	Women	₹ 205/day
B.	Output	
	Seed	₹ 150/kg

Table 3. Details of cost of cultivation (₹/ha) hybrid seed production of pigeonpea

Particulars	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}
i. Land preparation											
Ploughing	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700
Harrowing	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
ii. Seeds	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
iii. Fertilizers and manures											
FYM	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000
Urea	90	90	90	90	90	90	90	90	90	90	90
DAP	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700
iv. Growth regulators	-	4166	3298	520	200	7464	620	4266	7894	7564	8084
v. *Rhizobium*	80	80	80	80	80	80	80	80	80	80	80
vi. Plant protection chemicals	3755	3755	3755	3755	3755	3755	3755	3755	3755	3755	3755
vii. Labour charges											
For sowing	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
For hand weeding	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
Intercultivation	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
For spraying	3816	3816	3816	3816	3816	3816	3816	3816	3815	3815	3815
Harvesting and Threshing	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500
Total	43,941	48,107	47,239	44,461	44,041	51,405	44,561	48,207	51,925	51,505	52,025

.The data obtained from a set of observations for each character was tabulated and method of "Analysis of variance" and critical difference (C.D) was calculated as suggested by Fisher and Yates (1938).

Results and discussion

Pigeon pea hybrid seed yield was significantly influenced due to the different sources of foliar nutrients and growth regulators. Foliar spray of pulse magic @ 1% + 19:19:19 @ 1 % + NAA @ 50 ppm + Borax @ 0.2 % at flower initiation and pod formation stage recorded significantly higher seed yield (1,499 kg ha^{-1}) closely followed by T_{10} (1,405 kg ha^{-1}) , T_9 (1,266 kg ha^{-1}) and T_8 (1,137 kg ha^{-1}) as compared to control, which recorded the lowest seed yield (903 kg ha^{-1}). The respective increase in seed yield in these treatments was to an extent of 39.74, 35.72.76, 28.64 and 20.58 per cent over control. This might be due to improvement in the yield attributes which in turn dependent on higher availability of nutrients and growth regulators for uptake and favourable soil moisture content due to foliar application of nutrients and growth regulators. Thakur *et al.* (2017) reported yield enhancement and attributed to the improvement in growth and yield parameters, and also due to higher photosynthetic rate in foliar spray of pulse magic which might have enhanced the catalytic units of chloroplast.

Significantly higher gross returns, net returns, B:C ratio (Table 1, 2 and 3) were possible with foliar spray of Pulse magic @ 1%+ 19:19:19 @ 1% + NAA @ 50 ppm+ Borax @ 0.2 % (₹ 2,06,694, ₹ 1,61,159 and 4.19, respectively) followed by Pulse magic @ 1 %+ NAA @ 50 ppm (₹ 1,91,113, ₹ 1,44,869, 4.10 respectively). Significantly lower gross return, net return and B:C ratio were with control wherein no foliar sprays were undertaken (₹1,43,265, ₹ 1,00,764 and 3.27 respectively). Higher net returns were also reported by Raudal *et al.* (1999), Govinda *et al* 2016 and Ahlawat (2009) in their studies on pigeonpea.

Conclusion

From the results of the field trial, it was concluded that foliar sprays of Pulse magic @ 1 % + 19:19:19 @ 1 % + NAA @ 50 ppm + Borax @ 0.2 % at flower initiation and pod formation stages of pigeon pea crop along with application of recommended dose of fertilisers found optimum to obtain higher seed yield and higher net returns in hybrid seed production of pigeon pea.

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