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Influence of Foliar Application of Gibberalic Acid on Growth, Yield and Economics of Pigeonpea (*Cajanus cajan* L.)

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ABSTRACT: An experiment was conducted during *kharif* 2019-20 at Agriculture Research Station, Rajasthan to find out the impact of foliar application of gibberalic acid on growth, yield and economics of pigeon pea. The experiment was laid out in a Randomized Block Design with eleven treatments which were replicated thrice The results showed that treatment GA3 @ 75 ppm at flower initiation & pod initiation stages resulted maximum grain yield (1270 kg/ha) and proved significantly superior to control, Water spray at flower initiation (FI) and pod initiation stages (PI), GA3 @ 25 ppm at FI stage and GA3 @ 25 ppm at FI stage. Maximum net return (Rs. 36000/-) was obtained with the GA3 @ 50 ppm at FI & PI stages and Maximum B: C ratio (2.04) was obtained with GA3 @ 25 ppm at flower initiation & pod initiation stages.

Keywords: Pigeonpea, GA3, foliar application, Correlation and regression

INTRODUCTION

Pigeonpea commonly known as red gram or arhar is a very old crop of India. It is an important pulse crop of dry land agriculture because of its ability to produce economic yield under limited moisture condition. Due to high protein content pigeonpea is commonly used as a substitute for meat in a largely vegetarian population in India. India ranks Ist in area and production in the world. It is one of the most important *Kharif* pulses suitable for rainfed situation with an area of 4. 5 m ha, production 3.3 mt and productivity 729 kg/ha in the country (Anonymous, 2018-19). However, Area of pigeonpea in Rajasthan is 8859 ha and production 5196 t/ha with average productivity 587 kg/ha. (Anonymous, 2019-20).

There are biotic and abiotic factor that limit the true potential of pigeonpea. Economic loss due to abiotic factors is higher than the biotic factors. Among the abiotic factors frequent droughts are a major constraint that reduces production and productivity. In the semiarid tropics, pigeonpea is often grown as an intercrop in the rainy season and its reproductive growth occurs on residual moisture left after the harvest of a companion crop. Lack of moisture during the reproductive phase, especially in regions where farmers grow medium-to-long duration varieties, often leads to a situation of terminal drought, affecting crop yield substantially (Parthasarathy, *et al*., 2010).

In pigeonpea vegetative and reproductive stage, occurs side by side and hence always there is competition for available assimilates between vegetative and reproductive sinks. On the other hand, always there is a limitation of source particularly at flowering and pod development stages. Flower drop and fruit drop is affected by physiological constraints as well as genetic makeup that reduces pigeonpea yield considerably (Ojeaga and Ojehomon, 1972). Flower drop and fruit drop can be reduced considerably by adopting better agronomic management practices such as use of plant growth regulators. Plant hormones plays diverse and vital role in plant growth and development of crop. All the developmental stages of plant are controlled by plant growth harmones. Use of plant growth harmone improve physiological efficiency including photosynthetic ability of plant and offer significant role in improving crop yields. The plant growth regulators enhances the source sink relationship and stimulate the translocation of photo assimilates and thereby increase the productivity. Gibberellic acid (GA3) is growth promoting plant growth harmone that stimulates plant growth and development. It stimulate seed germination, trigger transitions from meristem to shoot growth, juvenile to adult leaf stage, vegetative to flowering, determines sex expression and grain development along with an interaction of different environmental factors viz., light, temperature and water (Gupta and Chakrabarty, 2013). Keeping all the facts in mind this experiment was conducted to find out the "Influence of foliar application of gibberalic acid on growth, yield and economics of pigeon pea (var. ICPL-88039) crop".

MATERIALS AND METHODS

The entitled experiment was conducted during the *kharif* 2019-20 at Agriculture Research Station, Ummedganj, Kota Rajasthan (25° 18'N; 77°23'E, 271 m of above mean sea level). The soil of experimental field was clay loam having low organic carbon (0.40%) and medium in available N (280.6 kg/ha) & P (19.6 kg/ha) and high in K (292 kg/ha) and (pH 7.2). Randomized block design with eleven treatments with three replications was used to conduct this experiment. The treatments [Control, Water spray at flower initiation and pod initiation stages (500 lit /ha), GA3 @ 25 ppm at FI, GA3 @ 50 ppm at FI stage, GA3 @ 75 ppm at flower initiation stage, GA3 @ 25 ppm at PI stage, GA3 @ 50 ppm at pod initiation stage, GA3 @ 75 ppm at pod initiation stage, GA3 @ 25 ppm at flower initiation & pod initiation stages, GA3 @ 50 ppm at flower initiation & pod initiation stages, GA3 @ 75 ppm at flower initiation & pod initiation stages] were taken. Two irrigations were applied to the crop before flowering and pod formation stage. Pre emergence application of pendimethalin (Dost 30 EC) @ 3 lt/ha was applied one day after sowing. A knapsack sprayer was used for spraying herbicides having a spray volume of 500 litres/ha. Two hand weeding was done at 20 and 40 DAS with the help of *Khurpi* in all treatments. Sowing was done with '*pora*' method in rows spaced at 60 cm with average depth of 5 cm and seed rate of 20 kg/ha of ICPL 8809 variety. During the crop growing period all the plant protection measures were adopted to take healthy crop. At harvesting stage, after leaving two rows on each side as well as 50 cm along the width of each side was harvested separately for recording the yield attributes and yields. The harvested material was tied and tagged and kept on threshing floor for sun drying. Pigeonpea seeds were cleaned by winnower and yield was recorded. Statistically significance of all the observations were tested using the *F*-test (Gomez and Gomez, 1984). The significant of difference between treatment means were compared with t critical difference at 5 % level of probability.

RESULTS AND DISCUSSION

A. Influence of foliar application of GA3 on growth attributes

Results showed that growth attributes such as plant height and number of branches per plant were significantly influenced by foliar application of gibberalic acid and significantly higher plant height and number of branches was found in GA3 @ 75 ppm at FI & PI stages which was significant over control and water spray at flower initiation and pod initiation stages (Table 1). Improvement in growth parameters of pigeonpea crop is due to the application of different concentrations of GA3 over untreated (control) is possibly due to the beneficial effects of GA3 on cell elongation and cell division, increase in photosynthetic activity and better food accumulation. The foliar application of GA3 at flower initiation and pod formation stage might have improved the reproductive development of pigeonpea crop and supported efficient translocation of photosynthates from source to sink. This might have significantly increased the number pods/ plant, grain mass and yield/ plant. Similar results were observed by Uddin (1999), Akter *et al.*, (2007) and Giri *et al.*, (2018).

Table 1: Influence of Gibberalic acid spray on growth and yield attributes of pigeonpea crop.

Treatments	Plant height (cm) at harvest	Branches/Plant	Pods/ plant	Seeds/ pod	Test weight (g)
T0:Control	188.1	11.30	103.21	3.20	80.82
T1:Water spray at flower initiation and pod initiation stages (500 lit /ha)	198.0	11.02	109.68	3.18	82.50
T2:GA3 @ 25 ppm at flower initiation stage	203.2	12.10	132.2	3.25	84.36
T3:GA3 @ 50 ppm at flower initiation stage	208.6	12.36	135.35	3.26	84.48
T4:GA3 @ 75 ppm at flower initiation stage	207.1	13.12	147.62	3.35	85.19
T5:GA3 @ 25 ppm at pod initiation stage	203.5	12.34	124.85	3.36	85.32
T6:GA3 @ 50 ppm at pod initiation stage	206.5	12.35	133.91	3.50	85.42
T7:GA3 @ 75 ppm at pod initiation stage	209.0	13.92	143.65	3.78	86.12
T8:GA3 @ 25 ppm at FI & PI stages	211.5	14.15	159.36	4.12	87.41
T9:GA3 @ 50 ppm at FI & PI stages	214.3	15.03	176.2	4.25	87.61
T10:GA3 @ 75 ppm at FI & PI stages	216.0	15.70	183.38	4.29	89.97
SEm ±	4.71	0.69	7.42	0.19	1.50
CD (P=0.05)	13.90	2.05	21.90	0.56	4.43

B. Influence of foliar application of gibberalic acid on yield attributes and yield

Results showed that Pods/plant, Seeds/ pod, test weight and grain yield (kg/ha) were significantly influenced by foliar application of gibberalic acid and found significantly higher in GA3 @ 75 ppm at flower initiation & pod initiation stages which was significant over control and water spray at flower initiation and pod initiation stages (Table 1 & 2). Two applications of 75 ppm GA3 at flowering and at pod development stages achieved significantly higher grain yield (1270 kg/ha) and it was higher by 46.82 % than control treatment. Assimilate translocation to reproductive sinks is vital for seed development. Seed set and filling cab be limited by availability and utilization assimilates (Asch *et al.*, 2005). The grain yield of pigeonpea crop was increased due to cumulative effect of yield attributing characters, enhanced photosynthetic efficiency and improvement in the capacity of the reproductive sinks to utilize the incoming assimilates due to the exogenous application of GA3. These results are in agreement with the work of Upadhyay and Ranjan (2015).

Harvest index (%) was not significantly influenced by the foliar application of gibberalic acid. However, numerically higher value of harvest index (23.38 %) was found in GA3 @ 75 ppm at flower initiation stage. The higher harvest index showed that, GA3 application accelerated assimilate supply to sink and better utilization of the incoming assimilates by the reproductive sinks, which is in agreement with the results of Akter *et al*., (2007).

C. Effect of foliar application of gibberalic acid on economics

Economics of pigeonpea production was significantly influenced by the GA3 application. Maximum net return (Rs. 36000/-) was obtained with the application of GA3 @ 50 ppm at flower initiation & pod initiation stages which was higher by Rs. 17830/- than that of no application of the GA3 (Rs. 18170/-). Maximum B: C ratio (2.04) was obtained with GA3 @ 25 ppm at flower initiation & pod initiation stages. Increased grain yield owing to application of GA3 significantly increased the gross and net monetary returns. The results confirm the findings of Azizi *et al*. (2012) and Giri *et al*., (2018).

D. Relationship between growth, yield attributes (X) and pigeonpea grain yield (Y)

Data showed that grain yield was significantly and positively correlated with all these attributes (Table 3). As such, the increase or decrease in seed yield. Result reported that every unit increase in number of branches/plant, pods/plant, seeds/pod, and test weight crop increased the grian yield of pigeonpea by 83.007, 5.191, 243.248 and 50.50 kg/ha, respectively.

Table 2: Effect of Gibberalic acid spray on yield and economics of pigeonpea crop.

Treatments	Grain yield (kg/ha)	Stalk yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Net return (Rs/ha)	B: C ratio
T0:Control	865	3635	4500	19.46	18170	1.57
T1:Water spray at flower initiation and pod initiation stages (500 lit /ha)	878	3741	4619	19.01	18924	1.59
T2:GA3 @ 25 ppm at flower initiation stage	1025	3996	5021	20.45	26325	1.79
T3:GA3 @ 50 ppm at flower initiation stage	1135	3993	5128	22.09	31580	1.92
T4:GA3 @ 75 ppm at flower initiation stage	1225	4017	5242	23.38	35675	2.01
T5:GA3 @ 25 ppm at pod initiation stage	1045	3896	4941	21.15	27485	1.83
T6:GA3 @ 50 ppm at pod initiation stage	1123	3996	5119	21.94	30884	1.90
T7:GA3 @ 75 ppm at pod initiation stage	1169	4027	5196	22.49	32427	1.92
T8:GA3 @ 25 ppm at FI & PI stages	1205	4174	5379	22.39	35640	2.04
T9:GA3 @ 50 ppm at FI & PI stages	1250	4199	5449	22.93	36000	1.99
T10:GA3 @ 75 ppm at FI & PI stages	1270	4530	5800	21.86	34910	1.90
SEm ±	58.30	132	149.04	1.02	1542	0.05
CD (P=0.05)	171.98	391	439.65	NS	4548	0.16

Sale price of Pigeonpea @ 5400/quintal

Table 3: Correlation coefficients (r) and regression equations for the relationship between seed yield (Y) (kg/ha) and growth and yield attributing characters of pigeonpea crop (X).

S. No.	Parameters	Correlation coefficient (r)	Regression equation $Y = a + b_y \times X$
1.	Number of branches/plant	0.887^{**}	$Y = 26.143 + 83.007\ X_1$
2.	Number of pods/plant	0.925^{**}	$Y = 376.973 + 5.191\ X_2$
3.	Number of seeds/pod	0.757^{**}	$Y = 233.816 + 243.248\ X_3$
4.	Test weight (g)	0.894^{**}	$Y = -3203.563 + 50.50\ X_4$

** Significant at 1 per cent level of significance

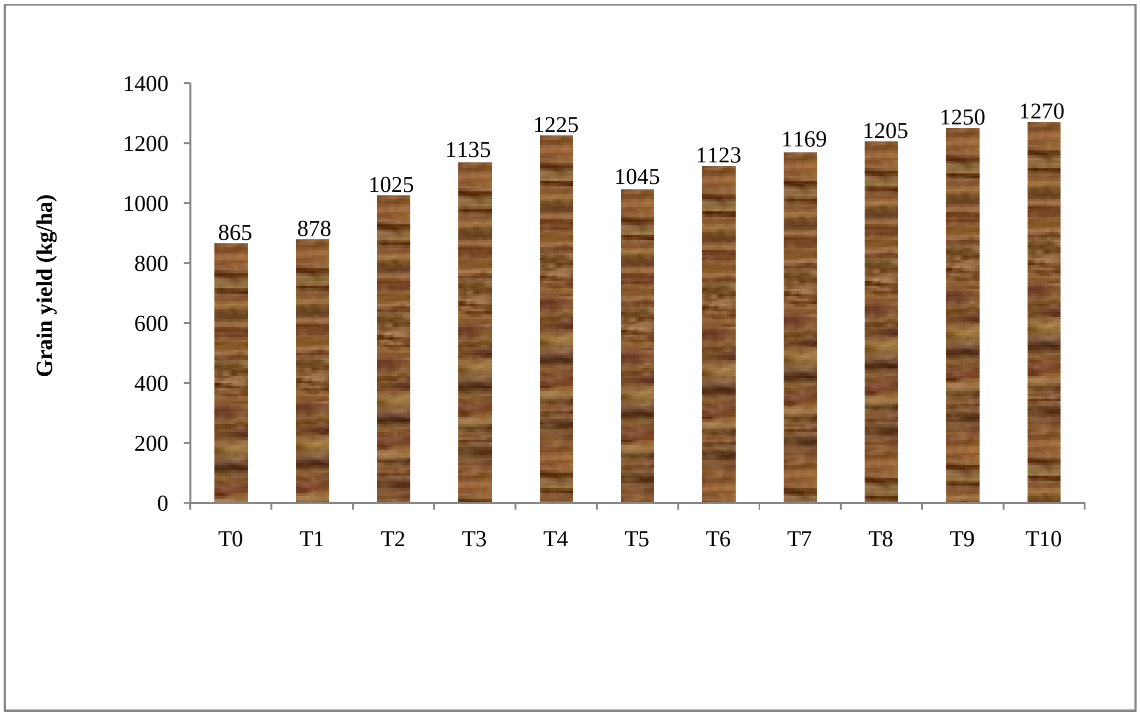

Fig 1. Effect of foliar application of gibberalic acid on grain yield of pigeonpea crop.

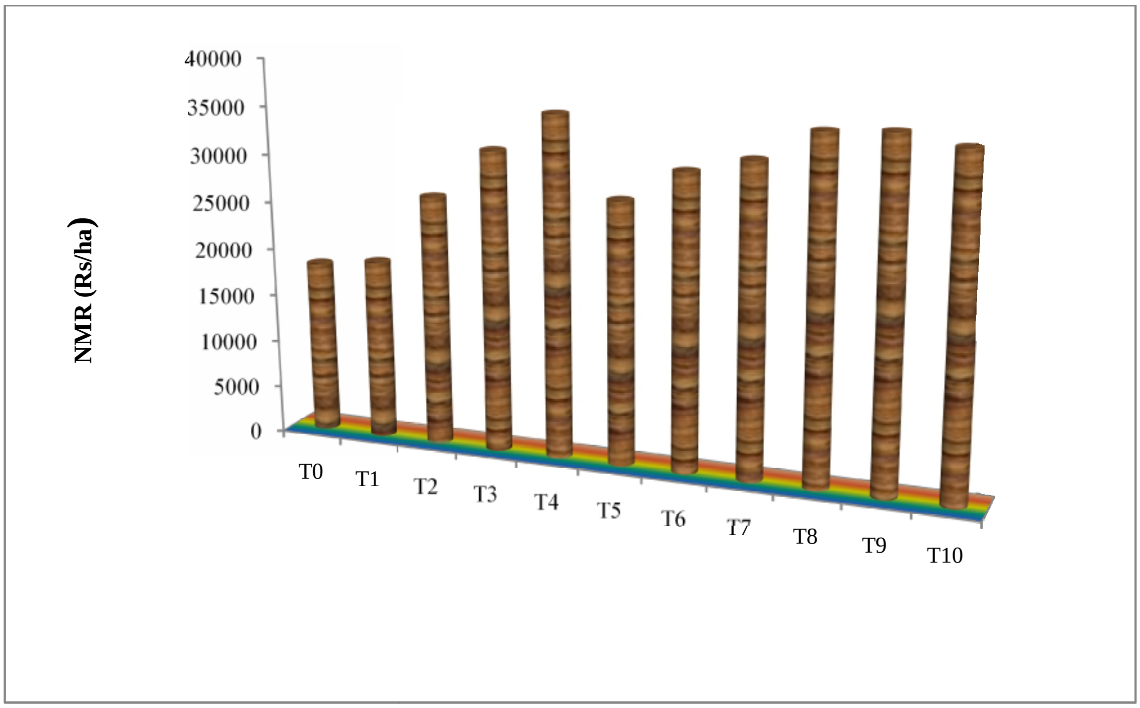

Fig. 2. Effect of foliar application of gibberalic acid on NMR (Rs/ha) of pigeonpea crop.

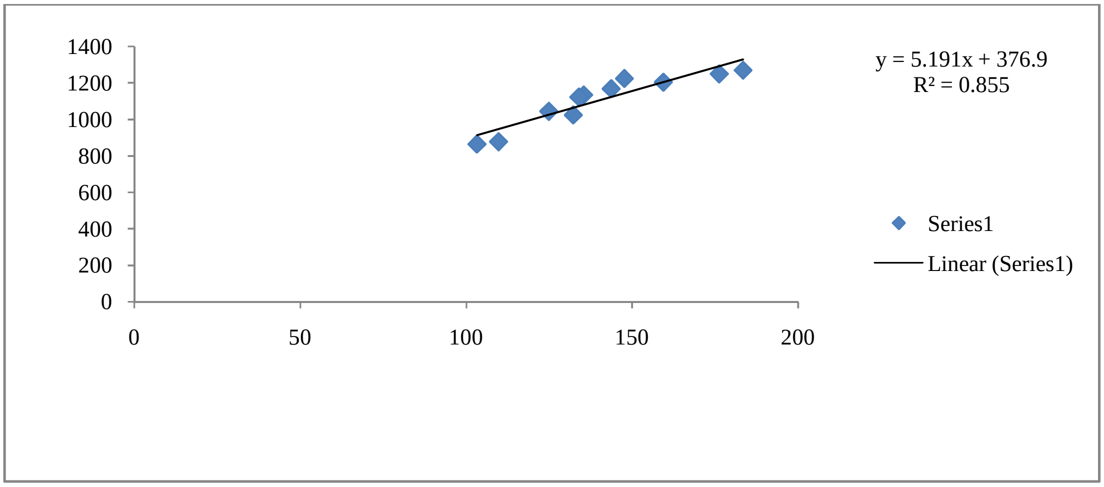

Fig. 3. Linear regression equation for the relationship between grain yield (Y) and pods per plant (X) of pigeonpea crop.

CONCLUSION

Based on the finding of the investigation it may be concluded that for obtaining optimum grain yield of pigeonpea with treatment GA3 @ 75 ppm at flower initiation stage is the best management practice. Whereas, optimum net return can be achieved with the foliar application of GA3 @ 50 ppm at flower initiation & pod initiation stages.

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