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Effect of Foliar Spray of Nutrients, Growth Regulators on Seed Yield and Quality in Hybrid Pigeonpea [*Cajanus cajan* (L.) Millsp]

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ABSTRACT

Background: The new generation special fertilizers have been introduced exclusively for foliar feeding and fertilization. The increased supply of nutrients and good response by plants resulted in enhanced translocation of nutrients to reproductive structures.Therefore, it is planned to study the effect of different nutrients as a foliar spray for growth, yield and seed quality parameters of hybrid pigeon pea.

Methods: The experiment on effect of foliar spray of nutrients, growth regulators on seed yield, quality in hybrid pegionpea [*Cajanus cajan* (L.) Millsp] was conducted at Seed Farm, College of Agriculture, Vijayapura, Karnataka during *kharif* 2019-2020. The treatment consisting of foliar spray of control (T_1), 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}), 1% Pulse magic+1% 19:19:19 + 50 ppm NAA+0.2% Borax (T_{11}). Foliar spray was taken at flower initiation and peak flowering stage.

Result: The results revealed that, foliar application of Pulse magic @1% +19:19:19@1%+ NAA@50 ppm + Borax@0.2% recorded higher number of branches (10.60), number of pods per plant (239.33), number of seeds per plant (5.75), test weight (12.18g), hybrid seed yield per plant (48.17g), hybrid seed yield per plot (1188.83g), hybrid seed yield per ha (1499kg /ha) and seed quality parameters *viz*: seed germination (93%), shoot length (15.08 cm), root length (18.67 cm), seedling vigour index(2649), lower electric conductivity (0.59 dSm^{-1}) and protein percentage (22.18 %) respectively.

Key words: Germination percentage, ICPH 2438, Pigeonpea, Pulse magic, Root length, Seedling vigour index.

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Millsp.] has the special morphological characters with respect to deep rooting and drought tolerance that have made this crop adaptable for growing in wide range of unfavourable conditions with uncertain rainfall and varied soil depth. Pulses are important food crops due to their high protein and essential amino acid content. It 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. Pigeonpea is regarded as a subsidiary crop, like other pulses. The farmers of rainfed Agroecosystems are growing pigeonpea as sole crop due to its mechanized harvesting and encouraged market price especially in Gulbarga, Raichur and Bidar districts of Karnataka. Pigeonpea hybrid technology is now established with farm hybrid advantage of 30-50%. The hybrid seed technology is profitable and easy to adopt.

Pigeonpea represents 6.22 million ha of world pulse's area and 4.74 million tonne of world's pulse production. (Anonymous 2018). In India pigeonpea occupied an area of 3.96 smillion ha with production of 2.56 million tonne. It is cultivated in larger part of the area is in states such as Maharashtra, Uttar Pradesh, Madhya Pradesh, Karnataka, Gujarat, Andhra Pradesh and Tamil Nadu, which together hold 87.89 per cent and 86.10 per cent area and production, respectively. It improves the soil by adding leaf fall, fixing atmospheric nitrogen and its profound, powerful root system crushes the plough pans and increases the soil structure which facilitates better moisture retention. Therefore, pigeonpea is often called a "biological plough". Due to the tap root system, it is able to resist drought for a longer period when there is uncertainty and inadequate accessibility of rainwater.

Stagnant production, soaring prices and enhanced imports of pigeonpea have been matter of concern to the prime stakeholders in India. A new hybrid pigeonpea breeding technology, developed jointly by the International

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crops Research Institute for the Semi-arid Tropics (ICRISAT) and Indian Council of Agriculture Research (ICAR) is capable of substantially increasing the productivity of pigeonpea and thus offering hope of pulse revolution in the country. The hybrid technology, based on cytoplasmic nuclear male-sterility (CGMS) system, has given an opportunity of achieving the long-cherished goal of breaking yield barrier in pigeonpea.Hybrid pigeonpea shares the advantages over varieties in the following areas increased seed yield, increased seedling vigour, reduced seed rate, greater drought tolerance, greater disease resistance.

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}). The low yield is mainly attributed to inadequate and imbalance application of nutrients. The prominent effect of foliar application of nutrients and growth regulator at pre-flowering and flowering stage was on reduction in flower shed and flower drop percentage. Foliar application of PGRs significantly increased both the growth attributes and yield (Sumathi *et al.,* 2018). To enhance the productivity with the application of nutrients through foliar sprays in addition to soil application, there are many benefits to augmenting crop dietary demands. 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). Hence, the present study was initiated to study the effect of foliar spray of nutrients, growth regulators on hybrid seed yield and quality in hybrid pigeonpea.

MATERIALS AND METHODS

The experiment on effect of foliar spray of nutrients, growth regulators on seed yield and seed quality in hybrid pigeinpea [*Cajanus cajan* (L.) Millsp] in *kharif* was conducted at Seed Farm, College of Agriculture, Vijayapura, during *kharif* 2019-2020. The experiment was laid out in randomised block design with different treatments *viz*: control (T_1), 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}), 1% Pulse magic+1% 19:19:19+50 ppm NAA+0.2% Borax (T_{11}). Foliar spray was taken at flower initiation and peak flowering stage. The observations were recorded on five plants selected by following systematic random sampling. Pigeonpea yield and component characters are days to 50% flowering, number of branches, number of pods per plant, number of seeds per pods, plant height, seed yield per plant, seed yield per hectare. Seed quality parameters like germination percentage, root length, shoot length, seedling vigour index, test weight, electric conductivity and protein content (Bradford, 1976). The data obtained from a set of observations on growth, seed yield and quality parameters were tabulated and method of "Analysis of variance" and critical difference (C.D) was calculated as suggested by Fisher and Yates (1938).

RESULTS AND DISCUSSION

The data on growth and yield parameters are presented in Table 1. The seed yield of 1499 kg per ha was obtained from pulse magic @ 1% + 19:19:19 @ 1% + NAA @ 50 ppm + Borax @ 0.2% followed by Pulse magic @ 1% + 19:19:19 @ 1% + NAA 50 ppm (1405 kg / ha) as compared to control (903 kg / ha). The increased hybrid seed yield might be due to increase in nutrient and growth regulators availability through foliar application of nutrient mixtures. It has been well established that hybrid seed yield finally depends on yield attributing characters. In the present investigation, significantly higher yield attributing characters *viz*., plant height (250.33 cm), number of branches (10.60), number of pods per plant (239.33), number of seeds per pods (5.75), test weight (12.18 g) and hybrid seed weight per plant (48.17 g) were obtained in pulse magic @ 1% + 19:19:19 @ 1% + NAA @ 50 ppm + Borax @ 0.2% was seen in Table 1 followed by treatment sprayed by Pulse magic @ 1%+ 19:19:19 @ 1% + NAA 50 ppm observed plant height (222.17 cm) number of branches (8.67), number of pods per plant (228), number of seeds per pod (5.67), hybrid seed yield per plant (45.67 g) respectively, sprayed plots compared to unsprayed control plots (111 cm, 6.40, 103.53, 3.33, 9.58 g and 39.17 g respectively). It might be attributed due to the application of nutrients and PGR at flowering and peak flowering stage which has helped in more translocation of photosynthates to the developing pods which in turn helped in better filing of grains, thus favoured the test weight (12.18 g) of the seeds compared to unsprayed plots (9.58 g). It was probable that application of NAA might have induced large number of new sinks leading to greater activity of carboxylating enzymes and rate of protein synthesis. Higher seed yield, stalk yield and nutrient uptake by the crop was recorded with foliar application of NAA and DAP applied at 60 and 80 DAS as reported by Nagamani *et al.* (2020). This resulted in higher photosynthetic rate, translocation and accumulation of metabolites in the sink and eventually greater seed production (Kalpana and Krishnarajan, 2003). Similarly, Vijaysingh *et al.* (2017) also reported benefits of foliar application of Pulse Magic in blackgram. Application of bio-regulators on crops is farmer friendly, convenient and effective approach for improving the productivity and quality of legume crops (Kumar, 2021).

The seed quality parameters were significantly influenced by foliar spray of nutrients and growth regulators (Table 2). Among the different foliar spray treatments Pulse magic @ 1% + 19:19:19 @ 1% + NAA 50 ppm + Borax @ 0.2% significantly higher seedling vigour index I and II observed 2649 and 407 respectively (Abdul-Baki and Anderson 1973), it is mainly due to seed quality parameters contributes higher germination (92.67%) (Anon, 2014), higher root and shoot length (18.67 cm and 15.08 cm), lower electric conductivity (0.59 dSm^{-1}) and higher seed protein

Table 1: Effect of different nutrients and growth regulators foliar spray on growth and hybrid seed yield parameters in pigeonpea.

Treatments	Plant height of seed parcent (cm)	Number of branches in seed par cent	Number of pods per plant in seed par cent	Total number of seeds per pod in seed parent	Test weight (g)	Hybrid seed yield per plant (g)	Hybrid seed yield per plot (g)	Hybrid seed yield per hectare (kg)
T_1	101.50	6.40	103.53	3.33	9.58	39.17	964.50	903.3
T_2	120.13	7.75	145.53	4.33	10.10	41.17	1027.30	930.00
T_3	118.33	7.49	124.67	4.0	10.0	39.50	999.00	916.33
T_4	111.67	7.87	129.93	4.0	9.70	40.83	1012.13	912.67
T_5	106.52	8.20	127.33	4.33	9.73	40.17	1010.50	1013.67
T_6	125.87	8.60	148.00	4.83	10.10	41.50	1051.17	1059.67
T_7	117.19	8.48	150	4.92	10.07	42.33	1060.97	1030.33
T_8	123.87	8.27	140.50	4.67	11.20	42.30	1055.08	1137.33
T_9	128.63	8.70	193.33	5.17	11.50	44.17	1106.87	1266.00
T_{10}	127.35	8.67	228	5.67	11.73	45.67	1155.17	1405.33
T_{11}	131.87	10.60	239.33	5.75	12.18	48.17	1188.83	1499.67
Mean	119.36	8.27	157.63	4.64	10.51	42.27	1057.41	1097.67
S.Em. ±	3.91	0.67	11.61	0.33	0.30	1.77	37.98	31.3
C.D. at 5%	11.26	1.96	34.25	0.98	0.90	7.24	112.04	94.56

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%.

Table 2: Effect of different nutrients and growth regulators foliar spray on seed quality parameters in pigeonpea.

Treatments	Germination (%)	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Vigour Index I	Vigour Index II	Electrical conductivity (dSm-1)	Protein (%)
T_1	84.00	9.75	13.08	26.64	20477	294.40	0.74	19.68
T_2	87.00	10.03	15.33	28.83	2180.0	338.00	0.68	20.95
T_3	85.67	10.17	15.83	32.17	2107.0	316.20	0.64	20.92
T_4	87.00	14.02	15.25	32.42	2138.0	323.00	0.626	21.49
T_5	88.73	13.12	14.42	31.75	2146.0	339.60	0.65	21.93
T_6	86.33	14.17	16.08	32.83	2300.0	344.50	0.653	21.92
T_7	88.50	13.17	15.92	32.42	2444.0	340.20	0.64	21.69
T_8	88.00	13.08	16.33	32.58	2395.0	342.40	0.633	21.30
T_9	89.00	13.27	18.33	34.08	2444.0	343.10	0.6266	21.65
T_{10}	89.50	14.92	18.08	36.83	2605.0	350.30	0.62	21.97
T_{11}	92.67	15.08	18.67	37.75	2649.0	407.00	0.59	22.18
Mean	87.85	12.80	16.14	32.77	2308.0	339.00	0.646	21.43
S.Em. ±	0.65	0.249	0.463	0.377	205.28	12.91	0.053	0.412
C.D. at 1%	1.87	0.730	1.847	1.503	818.416	37.16	0.154	1.643

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%.

(22.18%) as compared to other treatments (Table 2) and control recorded with a lower seedling vigour index I and II 2047, 294.40 which contributes to lower germination (84.00%), lower root and shoot length (13.08 cm and 9.75 cm), lower seedling length (26.64 cm), higher electric conductivity (0.74 dSm^{-1}) and lower protein content (19.68%) respectively. This is having a positive relation to seed development which is reflected through the size and test weight of seed and the micronutrients present in it. This in turn dependent on efficient synthesis, accumulation of food metabolites such as protein, carbohydrates and their translocation from source to the developing seed at greater ease. Seed with higher initial capital food reserves always showed higher and rapid germination which is also true in present study. Similarly, the micronutrients also participate in catalytic activity and breakdown of complex food source to simple form (glucose, amino acids and fatty acids). These in turn reflected on enhancing the germination and elongation of root and shoot. Whereas higher reading for conductivity match the seed lots with inferior quality and which is related to disruption of the membrane system, releasing higher rates of compounds into the watery environment. NAA and boron increases membrane integrity via a close arrangement of lipid and protein. It also enhances bonding between cellulose fibres in the cell wall. Similar results were reported by Kavitha *et al.* (2002) in black gram as seeds hardened and pelleting and foliar spray with micronutrients with 40 g DAP + 100 mg 50 ppm NAA + 100 mg $FeSO_4$ + 250 mg ammonium molybdate per kg of seed and Masuthi *et al.* (2009) with Zinc + Boron + Arappu leaf powder + 19:19:19 in cowpea.

CONCLUSION

From this study it could be concluded that growing of pigeonpea with foliar spray of Pulse magic @ 1% + 19:19:19 @ 1% + NAA 50 ppm + Borax @ 0.2% at flower initiation and peak flowering stage followed by Pulse magic @ 1% + 19:19:19 @ 1% + NAA 50 ppm as compared to control resulted in higher yield and seed quality parameters.

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Conflict of interest

All authors declared that there is no conflict of interest.

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