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Influence of foliar application of pulse magic, PGRs & nutrients on growth parameters and yield of Pigeon Pea

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Abstract
Pigeon pea is most important pulse crop in Kalburgi district of Karnataka. Yield of pigeon pea is decreasing due to flower drop and pod setting in climatic vulnerability situation. Field experiment was conducted to study source and sink relationship in pigeon pea (*Cajanus cajan l.)* as influenced by nutrients and plant growth regulators. The results in this investigation noticed that among all the treatments pulse magic spray on pigeon pea variety TS3R have significantly increased the yield (1442 kgha^{-1}) compared to the control (1182 kgha^{-1}) which increased the yield by 22% over control by improving the growth parameters such as plant height (166.20 cm), leaf area (47.63 dm^2 plant^{-1}), leaf area index (1.80), leaf area duration (84.71 days), absolute growth rate (0.94 g day $^{-1}$), crop growth rate (3.94 g dm^{-2} day $^{-1}$), total dry matter accumulation (195.36 g plant^{-1}) as compared to control (151.20 cm, 36.01 dm^2 plant^{-1}, 1.24, 66.46 days, 0.69 g day $^{-1}$, 2.17 g dm^{-2} day $^{-1}$ and 164.84 g plant^{-1} respectively). Pulse magic is a combi product, released by university of agricultural sciences, Raichur as it contains major nutrients, micro nutrients and PGR which helped the crop to achieve maximum yield potential.

Keywords: Pulse magic, absolute growth rate, crop growth rate, seed yield

Introduction
Pulses are popularly known as “poor man’s meat” and “rich man’s vegetable” (Singh and Singh, 1992). Pulses are excellent sources of proteins (25-40 per cent), carbohydrates (50-60 per cent), fats, minerals and vitamins. In addition to this they contain enzyme inhibitors, lectins, phytates, oxalates, polyphenols, saponins and phytosterols. Pulses contain two to three times more protein than cereals ranging approximately between 20 to 40 per cent (Arora, 1989) [3]. India is the largest producer, importer and consumer of pulses in world, which account 25 per cent of the global production and 27 per cent of total consumption. As sizeable population in the country depends on vegetarian diets to meets its protein requirement. The country produces a variety of pulses to the tune of 14 mt annually from an area of 22 mha with an average productivity of 637 kg ha-1. This production level still falls short of the domestic requirement of 18.33 mt, which is increasing consistently with growing population. The widening gap in demand and supply has led to soaring prices of pulses during the past two years (Ali and Gupta, 2012) [1].

Pigeon pea [*Cajanuscajan* (L.) Millsp.] is the fifth prominent pulse crop in the world and in India after chickpea. In India, pigeon pea is being cultivated over an area of 3.90 million hectares with an annual production of 3.17 million tonnes and a productivity of 813 kg per hectare. Karnataka occupies second place next to Maharashtra in production (0.729 MT) with a productivity of 824 kg/ha which is nearer to the national average of 909 kg per hectare (Anon., 2017) [2]. Pigeon pea also acts as a soil ameliorant and known to provide several benefits to the soil in which it is grown. The seeds and immature pods used by humans and leaves and husk is used as feed for animals and stem portion used for vermicomposting as fuel purpose. Pigeon pea enhances soil fertility through leaf litter and biological nitrogen fixation (Udhaya *et al*., 2015) [23]. Mineral nutrient deficiencies limit nitrogen fixation by the legume-rhizobium symbiosis, resulting in low legume yields. Nutrient limitations to legume production result from deficiencies of not only major nutrients but also micronutrients such as Molybdenum (Mo), Zinc (Zn), Boron (B) and Iron (Fe). Application of recommended doses of fertilizers (RDF), the major, secondary and micronutrients, to pigeon pea is essential for higher yield under rainfed conditions (Bhuiyan *et al*., 1999) [4].

Plant growth regulators can improve the physiological efficiency including photosynthetic ability and can enhance the effective partitioning of accumulates from source to sink in the field crops (Dhashora and Jain., 1994; Solamani *et al*., 2001) [7].

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PGRs more so when applied at flowering stage, hence flower and pod drop may be reduced to some extent by spraying various growth regulators (Ramesh and Thirumuguran., 2001) [15], which prove that yield and quality parameters in food legumes may be enhanced by suitable application of PGRs. In turn, the nutrients are known to alter the various physiological and biochemical functions which finally influences on the yield of the crop. Sometimes, soil applied nutrients are insufficient for crop to meet out their nutrient requirement and it may be due to non-availability of nutrients due to abrupt soil conditions, exhausted soil condition or nutrient losses through leaching and many more things which can hinder the availability of nutrients to plants and cease the plant growth, which ultimately affect the yield and quality of the crop produce. So, the foliar application of nutrients at critical stages of crop growth is most appropriate and accurate method of correcting the nutrient deficiencies and helps to attain maximum potential yield of the crop and ultimately sufficient plant nutrition is absolutely essential for improving their productivity (Thakur *et al*., 2017) [22]. Keeping the above background, the present investigation was taken up on growth parameters and yield of pigeon pea as influenced by pulse magic, nutrients and plant growth regulators.

Materials and methods

The field experiment was conducted during kharif 2017 at Agricultural Research Station, Kalburgi, UAS, Raichur under rain fed condition. It is situated at a latitude of 17o 34' North, longitude of 760 79' East and an altitude of 478 meters above mean sea level. The soil of the experiment site is clayey (Soil pH 8.3; EC 0.21 dSm-1). The available soil nitrogen, phosphorus and potassium were 241, 14.9 and 280 kg ha-1, respectively. The experiment was laid out in Randomized Complete Block Design (RCBD) with 10 treatments. The treatments *viz*., foliar spray of 2.0% 19:19:19 mixture (T1), 20ppm 6BA (T2), 100ppm Salicylic acid (T3), 10g/l Pulse magic (T4), 2% MAP (T5), 0.5% ZnSO4 (T6), 0.01% Boric acid (T7), Water spray (T8), Control (T9), Absolute control (T10) with 3 replications using TS3-R variety with spacing of 90×30 cm. Pulse magic is a biproduct developed and released by UAS, Raichur for increasing the yield of pulse crops. It contains 10 percent nitrogen, 40 percent phosphorous, 3 percent micronutrient and 20 PPM plant growth regulator. The two sprays were taken up at 2 stages *viz*., at 50% flowering stage and at 15 days after first spray. Basal dosage of fertilizer 25:50 kg N: P2O5 ha-1 was applied to all plots except absolute control. Five plants were tagged at random in net plot area for recording various growth parameters like number of as plant height (cm), leaf area (dm2 plant-1), leaf area index, leaf area duration (days), absolute growth rate (g day -1), crop growth rate (g dm-2 day -1), total dry matter accumulation (g plant-1) and also seed yield (kgha-1) was calculated and analyzed statistically.

Results and Discussion

The data on growth parameters and seed yield, number of pods per plant, pod length, 100-seed weight are presented in table-1. In present investigation the plant height was significantly higher with foliar application of Pulse magic @ 10 g/l (166.20 cm) followed by 19:19:19 @ 2% (162.93 cm) and Salicylic acid @ 100ppm (159 cm) as compared to control (151.20 cm). The increased plant height may be due to the stimulating action of auxin present in the compound which softens the cell wall by increasing in its plasticity followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation (Meena *et al*., 2012). Higher leaf area and LAI was maintained with the foliar application of Pulse magic @ 10g/l (47.63 dm2 plant-1, 1.80) which is combination of both nutrients and PGR might as arrest the chlorophyll degradation resulting in more assimilatory surface area for longer period. These results are quite in line with the findings of Surendar *et al*. (2013) [20] in black gram, Gupta *et al*. (2010) [9] in green gram and Veerabhadrappa and Yeledhalli (2004) [24] in groundnut. The use of combination of nutrients and growth regulator (Pulse magic) was found to be more effective in increasing LAD (84.71 days) as compared to control (66.46 days), which could be attributed to retention of leaves for longer duration. The present investigation is similar to the findings of Vijaysingh (2017) [25] in black gram and Shashikumar *et al*. (2013) [16] in black gram.

Higher AGR (0.94 g day -1) and CGR (3.94 g dm-2 day -1) value is obtained with foliar application of Pulse magic @ 10g/l as compared to control (0.69 g day -1, 2.17 g dm-2 day -1 respectively) and these results are in similarity with the findings of Vijaysingh (2017) [25] in black gram and Gagandeep *et al*. (2015) [8] in pigeon pea. The rapid increase in CGR observed under the effect of plant growth regulators and nutrients over that of control might be due to higher production of dry matter due to increased photosynthetic activities coupled with increased cell multiplication These findings are in conformity with the results obtained by Vijaysingh (2017) [25] in black gram, Sritharan *et al*. (2005) [19] in black gram and Gagandeep *et al*. (2015) [8] in pigeon pea.

In the present investigation, foliar application of Pulse magic @ 10 g/l has resulted in higher TDM accumulation (195.36 g plant-1) and its partitioning as compared to control (164.84 g plant-1). This higher percentage of TDM accumulation and its partitioning is due to the presence of 10 per cent of nitrogen, 40 per cent of phosphorus, 3 per cent of micronutrients and 20 ppm PGR, which governed the various physiological characters that ultimately increased the dry matter production and its partitioning to various parts at various stages of crop growth by increasing the various growth indices. The results of our investigation are similar with the findings Vijaysingh (2017) [25] in black gram and Chandrashekar and Bangaruswmay (2003) due to foliar spray of mixture of nutrients and PGR in green gram. Further, our results are also quite in line with the findings of Mondal *et al*. (2011) [14] in mungbean, Mannan. (2014) [12] in soybean and by Surendar *et al*. (2013) [20] in black gram. The average seed yield 1442 kg ha-1 of pigeon pea TS3R variety under pulse magic sprayed plot was found significantly higher seed yield compared to control 1182 kg ha-1 by improving the above-mentioned growth parameters. These findings are similar to the findings of J.R. Patil *et al*. (2018) [16] in green gram, Vijaysingh Thakur (2017) [22] in black gram and Teggelli *et al*. (2016) [21] in pigeon pea. Further, the results are in agreement with those of Chittapur *et al*. (1994) [6] in pigeon pea, Mondal *et al*. (2011) [14] in mungbean, Lateef *et al*. (2012) [11] in mungbean, Marimuthu and Surendran (2015) [13], Kuttimani and Velayutham (2011) [10] in green gram and by Shashikumar *et al*. (2013) [16] in black gram.

Table 1: Growth parameters and yield of pigeon pea as influenced by foliar application of major nutrients, minor nutrients and plant growth regulators

Treatments	Plant height (cm)	Leaf area (dm^2 $plant^{-1}$)	LAI	LAD (days)	AGR (g day^{-1})	CGR (g dm^{-2} day^{-1})	TDM (g $plant^{-1}$)	Seed yield (kg ha^{-1})
T_1 - Foliar application of NPK (19:19:19) mixture @ 2%	162.93	45.50	1.54	78.45	0.86	3.11	179.51	1372
T_2 - Foliar application of 6BA @ 20ppm	154.80	37.87	1.37	70.96	0.72	2.23	168.2	1205
T_3 – Foliar application of Salicylic acid @ 100ppm	159.00	45.39	1.51	77.84	0.85	2.99	176.28	1352
T_4 - Foliar application of Pulse magic @ 10g/l	166.20	47.63	1.80	84.71	0.94	3.94	195.36	1442
T_5 - Foliar application of MAP @ 2%	159.67	45.35	1.47	77.79	0.83	2.86	174.86	1328
T_6 - Foliar application of Zinc sulphate @ 0.5%	158.33	43.99	1.42	73.59	0.81	2.36	172.87	1282
T_7 - Foliar application of Boric acid @ 0.1%	157.43	43.84	1.41	72.24	0.80	2.32	170.76	1270
T_8 - Water spray	153.20	37.05	1.31	69.78	0.71	2.21	167.4	1186
T_9 – Control (RDF)	151.20	36.01	1.24	66.46	0.69	2.17	164.84	1182
T_{10} - Absolute control	148.60	34.21	1.18	62.99	0.49	1.42	128.61	982
S. Em (±)	3.37	0.69	0.08	2.10	0.02	0.28	3.64	34
C.D. at 5%	10.00	2.04	0.23	6.25	0.06	0.82	10.80	102

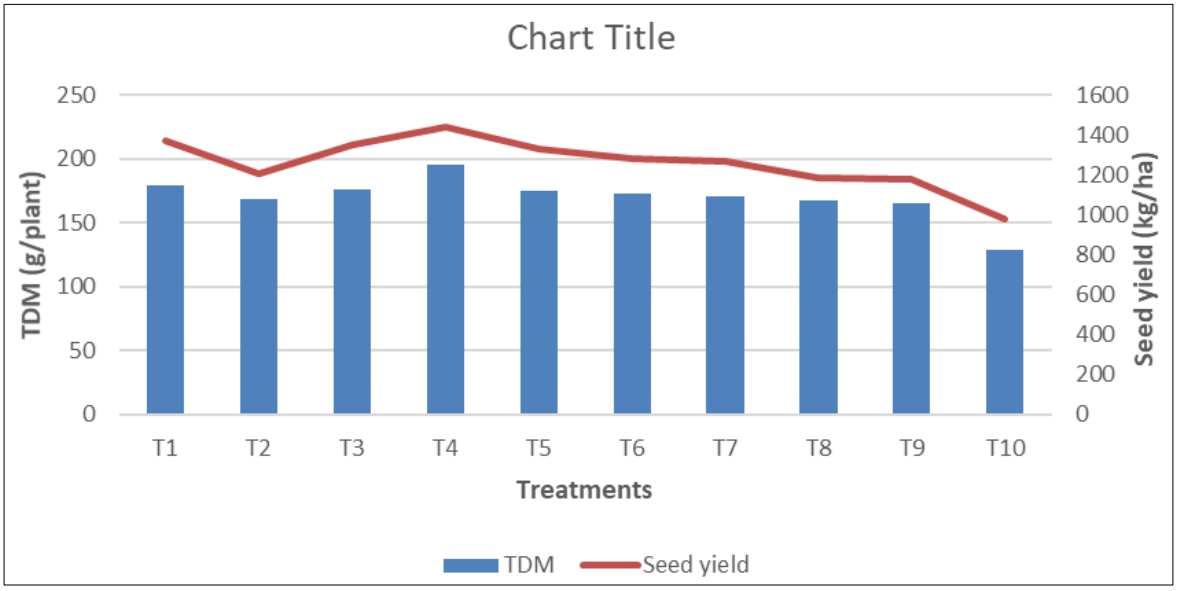

Fig 1: Seed yield (kg ha^{-1}) and TDM (g $plant^{-1}$) of pigeon pea as influenced by foliar application of major nutrients, minor nutrients and plant growth regulators

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