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EFFECT OF NUTRIENT LEVELS AND GROWTH REGULATORS ON TRANSPLANTED PIGEONPEA IN NORTHERN TRANSITION ZONE OF KARNATAKA

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ABSTRACT

A field experiment was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during *kharif,* 2017 to study the effect of nutrient levels and growth regulators on yield, yield parameters and economics of transplanted pigeonpea in rainfed condition. The experiment comprising of three nutrient levels as main plot treatments and four sub plot treatments of foliar application of micronutrients and growth regulators compared with one recommended package of practices (single control) were laid out in split plot design with three replications.

Application of 37.5:75 N:P_2O_5 kg ha^{-1} recorded significantly higher number of pods plant^{-1} (1,362), grain weight plant^{-1} (244.2 g), grains pod^{-1}(3.3), 100 grain weight (13.4 g), grain yield (2,958 kg ha^{-1}), net returns (₹ 1,24,642 ha^{-1}) and B:C ratio (3.6) as compared to application of 25:50 N:P_2O_5 kg ha^{-1} and was at par with the application of 50:100 N:P_2O_5 kg ha^{-1}. Among the foliar application of growth regulators and micronutrients, foliar spray of salicylic acid (0.02%) + $ZnSO_4$ (0.5%) + soluble boron (0.2%) at flowering and 15 days after flowering recorded significantly higher number of pods plant^{-1} (1,488), grain weight plant^{-1} (280.1 g), grains pod^{-1}(3.4), 100 grain weight (13.4 g), grain yield (3,230 kg ha^{-1}), net returns (₹1,39,722 ha^{-1}) and B:C ratio (3.9) as compared to foliar spray of NAA (0.05%) + $ZnSO_4$ (0.5%) + soluble boron (0.2%) and control (no growth regulators and micronutrients). Foliar spray of $ZnSO_4$ (0.5%) + soluble boron (0.2%) recorded on par results with the foliar spray of salicylic acid + $ZnSO_4$ + soluble boron. Whereas, control noticed significantly lower yield atrributes, net returns and B:C ratio. Among the interactions, significantly higher number of pods plant^{-1} (1,605), grain weight plant^{-1} (331.1 g), 100 grain weight (14.5 g), grain yield (3,484 kg ha^{-1}), net returns (₹ 1,53,217 ha^{-1}) and B:C ratio (4.2) were recorded with the application of 37.5:75 N:P_2O_5 kg ha^{-1} along with foliar spray of salicylic acid + $ZnSO_4$ + soluble boron as compared to other treatment combinations and present recommended package of practices.

(**Key words:** Growth regulators, nutrients, net returns, productivity, transplanted pigeonpea)

INTRODUCTION

Pulses are the important group of food crops belonging to the family Fabaceae. India ranks first in both area and production of all important pulses grown during *kharif.* As the pulses are mostly grown in rainfed conditions, special care and management has to be taken to sustain crop productivity. Among several factors limiting pulse production and productivity, abiotic stresses caused by erratic behavior of monsoon leads to delay in sowing or mid season dry spells. Low yield of pulses is also due to fact that they are sown on marginal lands with low fertility and poor nutrition; because of this we have not even exploited 50% of their potential yield levels. To meet the present requirements and fulfill the future projected demands of pulses by 2030 A.D., an annual growth rate of 4.2% production is required. Hence, there is a need to enhance the productivity of pulses by adopting good plant nutrition techniques. Pigeonpea [*Cajanus cajan* (L.)Millsp.] is one of the most important remunerative pulse crops which is being cultivated and consumed by major countries of the world. It also plays an important role in sustaining soil fertility by improving physical properties of soil and fixing atmospheric nitrogen. Being a hardy, deep rooted and long duration crop it can overcome aberrant weather conditions.

In India, pigeonpea occupies an area of about 3.85 million ha with a total production of 2.80 million tones with an average productivity of 729 kg ha^{-1} (Anonymous, 2017). It is extensively grown under rainfed conditions,the state of Maharashtra leads in both area (1.21 million ha) and production (0.76 m t) followed by Karnataka with an area and production of 0.82 million ha and 0.47 million tones,

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respectively with the productivity of 651 kg ha^{-1} (Anonymous, 2017).

Raising seedlings in poly bags or portrays and transplanting is one of the best practices for enhancing the productivity in pigeonpea. It ensures early establishment of crop under rainfed conditions and put forth good vegetative growth with early monsoon rains. It has advantage to cope up with delay in onset of monsoon. With limited water the seedlings could be raised and ready to transplant in 25-30 days. The transplanted crop has given better yield (25-30 q ha^{-1}) than direct sown crop (10-15 q ha^{-1}). Recently growing of transplanted pigeonpea is gaining importance as it is more productive under normal monsoon and sustains yields under climatic aberrations (Sujatha *et al.*, 2018).

The low yield of pigeonpea is mainly attributed to delay sowing, inadequate and imbalanced nutrient application particularly with respect to nitrogen and phosphorus. The shredding of flower is also a major problem under abiotic stress situations. In transplanted pigeonpea there is better crop growth and higher biomass production, the potential for yield is higher, which offers scope for better nutrient management and growth regulators. Hence, optimizing the nutrient requirement of the crop, provides greater opportunity to get higher and sustainable yield levels. However, the studies related to nutrient management practices and use of growth regulators in transplanted pigeonpea is very much limited. With this background, the experiment was conducted to study the effect of fertility levels and plant growth regulators in transplanted pigeonpea.

MATERIALS AND METHODS

The experiment was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka on medium black soil under rainfed condition during *kharif* 2017.During the crop growth period, a total rainfall of 582.8 mm was received which was optimum for good growth and higher yield. The soil of the experimental site was clay with pH 7.1 and EC 0.32 dS m^{-1}. The soil was medium in organic carbon (0.53%) and low in available nitrogen (249 kg ha^{-1}) and medium in available P_2O_5 (28 kg ha^{-1}) and available K_2O (286 kg ha^{-1}). The experiment was laid out in split plot design with three nutrient levels (25:50 N:P_2O_5 kg ha^{-1}, 37.5:75 N:P_2O_5 kg ha^{-1} and50:100 N:P_2O_5 kg ha^{-1}) as main plot treatments and four foliar application of micronutrients and growth regulators [NAA (0.05%) + zinc sulphate (0.5%) + soluble boron (0.2%); salicylic acid (0.02%) + zinc sulphate (0.5%) + soluble boron (0.2%); zinc sulphate (0.5%) + soluble boron (0.2%) and control (no growth regulators and micronutrients)]as sub plot treatments and one single control with application of FYM 6 t ha^{-1} + 25:50 N:P_2O_5kg ha^{-1} + $ZnSO_4$15 kg ha^{-1} + soluble boron 2.5 kg ha^{-1} soil application at the time of planting and treatmnts are replicated thrice.

Seeds of pigeonpea variety 'TS 3R' were dry seed dressed with *Trichoderma* at the rate of 4 g kg^{-1} seed and later treated with *Rhizobium* and *Pseudomonas fluroscence* P solubilizing culture at the rate of 500 g ha^{-1} seed. The seedlings were raised by sowing healthy bold treated pigeonpea seeds in polythene covers (size 15 cm x 6 cm) filled with soil and vermicompost during last week of May. The seedlings were regularly watered daily for 4 weeks in the nursery to raise healthy seedlings.Marking was done with the help of marker as per the recommended spacing (120 cm x 60 cm) and at each hill small pits were opened with the help of picax to a depth of 15-20 cm and then pigeonpea seedlings were transplanted after removing the polythene cover without disturbing the soil at the root zone of the pigeonpea seedling immediately after soaking rains during last week of June. The recommended quantity of FYM (6 t ha^{-1}) was applied two weeks before transplanting of the crop. During transplanting entire quantity of nitrogen and phosphorus were applied in the form of urea and DAP as per the treatments (25:50 N:P_2O_5kg ha^{-1}, 37.5:75 N:P_2O_5 kg ha^{-1} and 50:100 N:P_2O_5 kg ha^{-1})to each plot in the form of ring around the plant and covered with soil.Foliar application of growth regulators NAA (0.05%) and salicylic acid (0.02%) along with micronutrients $ZnSO_4$ (0.5%)and soluble boron (0.2%)was done at flowering and 15 days after flowering. At each foliar application, 750 litres of spray solution mixture ha^{-1} was used. Spray solution was prepared accordingly with the recommended concentrations and the zinc sulphate was neutralized with lime before spray in order to avoid scorching effect on plants.Observations on number of pods plant^{-1}, grain weight plant^{-1}, number of grains pod^{-1}, 100 grain weight , grain yield ha^{-1}, husk and stalk yield ha^{-1}, harvest index , net returns and B:C ratio were taken. The data collected from the experimental field were subjected to statistical analysis. Standard statistical methods were used (Gomez and Gomez., 1984) and the observations were undertaken (Table 1).

RESULTS AND DISCUSSION

Effect of nutrient levels and growth regulators on yield parameters and yield

In pigeonpea yield is dependent upon the sum total of growth and development of crop at different phenological stages and is the cumulative expression of different yield attributes. The yield attributing characters of transplanted pigeonpea were found to be greatly influenced by the application of nutrients and growth regulators. Significantly higher grain yield (2958 kg ha^{-1}) was recorded with the application of 37.5:75 N:P_2O_5 kg ha^{-1} (N_2) as compared to present recommended dose of 25:50 N:P_2O_5 kg ha^{-1} (2673 kg ha^{-1}) but it was found of par (2908 kg ha^{-1}) with the application of 50:100 N:P_2O_5 kg ha^{-1}(N_3). The increase in yield with the application of 37.5:75 N:P_2O_5 kg ha^{-1} over the application of 25:50 N:P_2O_5 kg ha^{-1}(N_1) was 10%. The data in our present study was also supported by Tulasi *et al.* (2014), who also reported the higher yield attributes and yield were recorded by the application of 150% RDF than its lower levels in sesame. Significant increase in grain yield in the treatment N_2on application of higher levels of nitrogen and phosphorus was largely a function of improved growth, translocation of more photosynthates towards sink and consequent improvement in yield attributes like number of pods plant^{-1} (1362), grain weight plant^{-1} (244.2 g) and 100-grain weight (13.4 g) of transplanted pigeonpea (Table 1).

Among the different foliar sprays of micronutrients and growth regulators, salicylic acid (0.02%) + $ZnSO_4$ (0.5%) + soluble boron (0.2%) at flowering and 15 days after flowering, recorded significantly higher grain yield (3230 kg ha^{-1}) with its attributing characters like number of pods plant^{-1} (1,488), grain weight plant^{-1} (280.1 g) and 100 grain weight (13.4 g) compared to no spray which recorded significantly lower grain yield (2307 kg ha^{-1}) and yield attributing characters like number of pods plant^{-1} (1,062), grain weight plant^{-1} (133.6 g) and 100 grain weight (12.1 g). The increase in grain yield and yield attributing characters with foliar spray of salicylic acid (0.02%) + $ZnSO_4$ (0.5%) + soluble boron (0.2%) over control (no spray of micronutrients and growth regulators) was to an extent of 29% (grain yield), 29% (number of pods plant^{-1}), 52% (grain weight plant^{-1}) and 10% (100-grain weight). These findings are in accordance with that of Ali and Adel (2013), who reported that higher yield attributes and yield were obtained in mungbean plants sprayed with 150 mg l^{-1} of salicylic acid and 500 mg l^{-1} zinc.

Flower initiation and at later period, assimilates are not yet partition towards sink from the source, as the vascular connection to the sink is broken by formation of abscission layer. Foliar spray of salicylic acid (0.02%) + $ZnSO_4$ (0.5%) + soluble boron (0.2%) accelerated the assimilates partitioning by destructing the action of abscission layer as it recorded significantly higher 100 grain weight (13.4 g). The results are in line with the findings of Thakare *et al.* (2006), who reported higher yield in soybean by the application of RDF along with foliar spray of NAA and DAP.

In the present study, the treatments with foliar spray of micronutrients along with growth regulators have recorded higher grain weight plant^{-1} (Table 1) upto 10% as compared to no spary. The main reason being the benefits obtained out of zinc and boron spray and their advantages are indicated in the findings of Tiwari *et al.* (2011) , who reported that zinc increases the photosynthetic activity and delays the senescence of leaves, thereby enhances the supply of photosynthates available for grain filling thus , results in bigger grains and ultimately yield increase as seen in soybean.Foliar application of boron found advantageous over soil application of boron in the present study. Foliar application of growth regulators and micronutrients recorded significantly higher grain yield (9%), number of pods plant^{-1} (9%), grain weight plant^{-1} (26%) and 100 grain weight (9.7%) over single control. The increased number of pods plant^{-1} (1,488) was mainly due to reduced flower drop and more number of pod set plant^{-1} with the foliar spray of micronutrients and growth regulators (Table 1).

Husk and stalk yield is primarily a function of vegetative growth of the crop in terms of number of leaves plant^{-1}. The better fertilization to the crop and other management practices influence husk and stalk yield of the crop. In the present study, application of balanced fertilization significantly influenced the husk and stalk yield (11,511 kg ha^{-1}) of transplanted pigeonpea at 50:100 N:P_2O_5 kg ha^{-1} but it was at par with 37.5:75 N:P_2O_5 kg ha^{-1}, respectively (Table 1).

Interactions effect of nutrient levels and combined foliar spray of micronutrients and growth regulators

Significantly higher grain yield (3,484 kg ha^{-1}), higher number of pods plant^{-1} (1,605), grain weight plant^{-1} (331.1 g), number of grains pod^{-1} (3.7) and 100 grain weight (14.5 g) were recorded with the application of 37.5:75 N:P_2O_5 kg ha^{-1} (N_2) along with foliar spray of salicylic acid + $ZnSO_4$+ soluble boron (F_2) when compared to other treatment combinations except with the application of 37.5:75 N:P_2O_5 kg ha^{-1}along with foliar spray of NAA + $ZnSO_4$ + soluble boron (F_1) and foliar spray of $ZnSO_4$ + soluble boron (F_3) and application of 50:100 N:P_2O_5kg ha^{-1} (N_3) along with foliar spray of salicylic acid + $ZnSO_4$ + soluble boron and foliar spray of $ZnSO_4$ + soluble boron which were at par with each other. Similar results were recorded in pigeonpea by Rameshwar (2003) , who reported that the yield attributing characters and yield of pigeonpea were higher with foliar spray of IAA + boron + zinc and least impact was observed in IAA and micronutrients spray alone. The increase in grain yield was 18% with treatment N_2F_2 as compared to present recommended practice. The former treatment noticed 13% higher grain yield over single control with N_2F_3 (Table 1).

Significantly higher husk and stalk yield (13,012 kg ha^{-1}) was recorded with the application of 50:100 N: P_2O_5 kg ha^{-1} along with foliar spray of salicylic acid + $ZnSO_4$ + soluble boron when compared to single control. Significantly lower stalk and husk yield was recorded with the application of 25:50 N:P_2O_5kg ha^{-1}without foliar spray (8,066 kg ha^{-1}) and application of 37.5:75 N:P_2O_5 kg ha^{-1} without foliar spray (8,553 kg ha^{-1}) and the at par results were obtained with all the remaining treatment combinations (Table 1).

Effect of nutrient levels and growth regulators on economics of transplanted pigeonpea

Significantly higher net returns (₹1,24,642 ha^{-1}) and benefit : cost ratio (3.6) were recorded with the application of 37.5:75 N:P_2O_5 kg ha^{-1} and it was at par with the application of 50:100 N:P_2O_5 kg ha^{-1} (Table 1). This was due to the higher grain yield of crop. These findings were in agreement with the findings of Singh *et al.* (1994) ,who recorded higher net returns with 50 kg N + 100 kg P_2O_5 ha^{-1} in pigeonpea.

Among different foliar sprays of micronutrients and growth regulators in transplanted pigeonpea, foliar spray of salicylic acid + $ZnSO_4$ + soluble boron recorded significantly higher net returns (1,39,722 ha^{-1}) and benefit : cost ratio (3.9) and was at par with the treatment sprayed with $ZnSO_4$ + soluble boron (Table 1).

Table 1. Yield parameters, yield and economics of transplanted pigeonpea as influenced by different nutrient levels and growth regulators

Treatments	Yield parameters				Yield			Economics	
	No. of pods plant^{-1}	Grain wt. plant^{-1} (g)	No. of grains Pod^{-1}	100 grain wt. (g)	Grain yield (kg ha^{-1})	Husk & stalk yield (kg ha^{-1})	Harvest Index	Net returns (₹ ha^{-1})	B:C ratio
Nutrient levels (N)									
N_1	1,227^{b}	182.3^{c}	2.9^{b}	12.1^{b}	2,673^{b}	9,701^{b}	21.7^{a}	1,09,051^{b}	3.3^{b}
N_2	1,362^{a}	244.2^{a}	3.3^{a}	13.4^{a}	2,958^{a}	10,881^{ab}	21.4^{a}	1,24,642^{a}	3.6^{a}
N_3	1,339^{a}	209.9^{b}	3.2^{ab}	12.8^{a}	2,908^{ab}	11,511^{a}	20.4^{a}	1,21,974^{ab}	3.5^{ab}
S E(m) ±	30.81	4.47	0.09	0.18	68	381	0.89	3,681	0.08
Foliar application of growth regulators and micronutrients (F)									
F_1	1,293^{b}	193.2^{b}	3.2^{a}	12.5^{ab}	2,809^{b}	10,919^{a}	20.7^{a}	1,16,239^{b}	3.4^{b}
F_2	1,488^{a}	280.1^{a}	3.4^{a}	13.4^{a}	3,230^{a}	11,506^{a}	22.1^{a}	1,39,722^{a}	3.9^{a}
F_3	1,394^{ab}	241.7^{a}	3.3^{a}	13.4^{a}	3,039^{ab}	11,161^{a}	21.5^{a}	1,29,986^{ab}	3.7^{ab}
F_4	1,062^{c}	133.6^{c}	2.6^{b}	12.1^{b}	2,307^{c}	9,205^{a}	20.3^{a}	88,275^{c}	2.9^{c}
S E(m)±	41.52	9.79	0.11	0.28	90	557	0.89	1,341	0.03
Interaction (N×F)									
$N_1 F_1$	1,258^{bc}	186.8b^{cd}	3.2^{a-c}	12.4^{cd}	2,732^{cd}	10,215^{a-c}	21.2^{a}	1,11,972^{d}	3.3^{c}
$N_1 F_2$	1,362^{ab}	224.9^{b}	3.0^{bc}	12.1^{d}	2,957^{b-d}	10,172^{a-c}	22.6^{a}	1,24,092^{b-d}	3.6^{a-c}
$N_1 F_3$	1,322^{ab}	198.7^{bc}	2.9^{cd}	13.1^{a-d}	2,909^{b-d}	10,352^{a-c}	22.2^{a}	1,23,892^{b-d}	3.6^{a-c}
$N_1 F_4$	967^{d}	118.9^{e}	2.4^{d}	11.3^{e}	2,096^{e}	8,066^{c}	20.7^{a}	76,251^{e}	2.6^{d}
$N_2 F_1$	1,337^{ab}	202.4^{b}	3.3^{a-c}	12.9^{b-d}	2,902^{b-d}	11,146^{ab}	20.5^{a}	1,21,916^{b-d}	3.5^{a-c}
$N_2 F_2$	1,605^{a}	331.1^{a}	3.5^{a-c}	14.5^{a}	3,484^{a}	11,333^{a-c}	23.6^{a}	1,53,217^{a}	4.2^{a}
$N_2 F_3$	1,538^{ab}	299.3^{a}	3.7^{a}	14.2^{ab}	3,338^{ab}	12,172^{a}	21.6^{a}	1,46,694^{ab}	4.0^{ab}
$N_2 F_4$	971^{cd}	144.2^{c-e}	2.4^{d}	12.1^{d}	2,108^{e}	8,553^{bc}	20.0^{a}	76,743^{e}	2.6^{d}
$N_3 F_1$	1,287^{b}	190.5^{b-d}	3.2^{a-c}	12.1^{d}	2,793^{cd}	11,078^{a-c}	20.3^{a}	1,14,832^{cd}	3.3^{c}
$N_3 F_2$	1,497^{ab}	284.6^{a}	3.6^{ab}	13.8^{a-c}	3,249^{a-c}	13,012^{a}	20.1^{a}	1,41,859^{a-c}	3.9^{a-c}
$N_3 F_3$	1,323^{ab}	227.2^{b}	3.3^{a-c}	12.8^{b-d}	2,872^{b-d}	10,958^{a-c}	20.8^{a}	1,19,375^{b-d}	3.4^{bc}
$N_3 F_4$	1,252^{b-d}	137.6^{c-e}	3.1^{a-c}	12.5^{cd}	2,717^{d}	10,995^{a-c}	20.1^{a}	1,11,832^{d}	3.3^{c}
S.E(m)±	71.92	16.95	0.19	0.48	155	965	1.53	7,346	0.15
Single control (SC)									
SC	1,351	207.8	3.3	12.1	2,933	10,646	21.67	1,24,103	3.6
S E(m)±	69.30	15.26	0.17	0.57	150	913	1.52	8,502	0.18
LSD(0.05)	202.26	44.54	0.50	1.66	438	-	-	24,815	0.52

Sale price:Grain yield- ₹5,400 quintal^{-1},Husk yield-1,200 tonne^{-1}

N = Nutrient levels:N_1 = 25:50 N:P_2O_5kg ha^{-1},**N_2** = 37.5:75 N:P_2O_5 kg ha^{-1}, **N_3** = 50:100 N:P_2O_5 kg ha^{-1}

F = Foliar application of growth regulators and micronutrients:

F_1 = NAA (0.05%) + $ZnSO_4$(0.5%) + soluble boron (0.2%)

F_2 = Salicylic acid (0.02%) + $ZnSO_4$(0.5%) + soluble boron (0.2%)

F_3 = $ZnSO_4$(0.5%) + soluble boron (0.2%)

F_4 = Control (No spray)

Single Control = FYM 6 t ha^{-1} + 25:50 N:P_2O_5 kg ha^{-1} + $ZnSO_4$15 kg ha^{-1} + soluble boron 2.5 kg ha^{-1}

Interaction effect

Significantly higher net returns (₹ 1,53,217 ha^{-1}) and B:C ratio (4.2) were recorded with the application of 37.5:75 $N:P_2O_5$ kg ha^{-1} along with foliar spray of salicylic acid + $ZnSO_4$ + soluble boron when compared to other treatment combinations except with the application of 37.5:75 $N:P_2O_5$ kg ha^{-1} along with foliar spray of $ZnSO_4$ + soluble boron and application of 50:100 $N:P_2O_5$ kg ha^{-1} with foliar spray of salicylic acid + $ZnSO_4$ + soluble boron which were at par with each other. Significantly higher benefit : cost ratio (4.4) was recorded with the application of 37.5:75 $N:P_2O_5$kg ha^{-1} kg along with foliar spray of salicylic acid + $ZnSO_4$ + soluble boron. Application of 37.5:75 $N:P_2O_5$ kg ha^{-1} along with foliar spray of NAA + $ZnSO_4$ + soluble boron, foliar spray of $ZnSO_4$ + soluble boron and application of 50:100 $N:P_2O_5$kg ha^{-1} with foliar spray of salicylic acid + $ZnSO_4$ + soluble boron, application of 25:50 $N:P_2O_5$ kg ha^{-1}along with foliar spray of salicylic acid + $ZnSO_4$ + soluble boron and foliar spray of $ZnSO_4$ + soluble boron were at par with each other (Table 1). Similar results were recorded in pigeonpea by Rameshwar (2003) , who recorded higher net returns with the application of lAA + boron + zinc in combination and lower with applying alone.

From the study it can be inferred that, application of 37.5:75 $N:P_2O_5$ kg ha^{-1} was found optimum for higher productivity and profitability of transplanted pigeonpea as compared to present dose of application of 25:50 $N:P_2O_5$ kg ha^{-1} in direct sown pigeonpea as it produced higher yield parameters and net profit. Among foliar spray of micronutrients and growth regulators, foliar spray of salicylic acid (0.02%) + $ZnSO_4$ (0.5%) + soluble boron (0.2%) at flowering and 15 days after flowering was found to be optimum as produced higher yield and profits as compared to no spray. Combined application of 37.5:75 $N:P_2O_5$ kg ha^{-1} and foliar spray of salicylic acid (0.02%) + $ZnSO_4$ (0.5%) + soluble boron (0.2%) found to be the best combination with respect to higher productivity and profitability in transplanted pigeonpea.

REFERENCES

Ali, E. A. and M. M. Adel, 2013.Effect of foliar spray by different salicylic acid and zinc concentrations on seed yield and yield components of mungbean in sandy soil. Asian J. Crop Sci. **5**(3): 33-40.

Anonymous, 2017. Area, production and productivity, Ministry of Agriculture and Farmers Welfare, Government of India,Website:-http://www.Indiastat.com

Gomez, K. A. and A. A. Gomez, 1984.Statistical Procedures for Agricultural Research. An International Rice Research Institute Book, A Wiley Interscience, John Wiley and Sons Inc., New York, USA.

Rameshwar, P. 2003. Impact of foliar application of indole acetic acid (IAA), boron and zinc on physiology and sink capacity of pigeonpea [*Cajanus cajan* (L.) Millsp.].M. Sc. (Agri.) Thesis, Indira Gandhi Agric. Univ., Raipur.

Singh, R. C., A. S. Faroda, D. Singh and P. Harbir, 1994. Response of pigeonpea to phosphate fertilization under different cropping systems. Indian J. Agron., **31**(3): 244-247.

Sujatha, H. T., H. B. Babalad, H. T. Chandranath and P. L. Patil, 2018.Crop growth and yield performance of pigeonpea as influenced by transplanting, planting geometry and intercropping systems. J. Soils and Crops. **28**(2): 289-294.

Thakare, K. G., C. N. Chore, R. D. Deotale, P. S. Kambale and S. R.Lende, 2006. Influence of nutrients and hormones on biochemical and yield and yield contributing parameters of soybean. J. Soils and Crops.**16**(1): 210-216.

Tiwari, R. J., M. D. Vyas and A. K. Jain, 2011.Long term effect of micronutrients and FYM on yield and nutrient uptake by soybean.Indian J. Soil Sci.**51**(1): 45-47.

Tulasi, L. T., S. M. Nawlakhe, D. D. Mankar, M. Shrinivasrao and V. B. Gauri, 2014.Growth, yield and quality of summer sesame as influenced by the fertilizer and sulphur levels. J. Soils and Crops. **24**(1):143-147.

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