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IMPACT OF FOLIAR SPRAYS OF CHITOSAN AND IBA ON CHEMICAL, BIOCHEMICAL AND YIELD CONTRIBUTING PARAMETERS OF PIGEONPEA

Rajesh D. Deotale[1], O. G. Thakare[2], P. V. Shende[3], Shanti R. Patil[4], S. R. Kamdi[5], M. P. Meshram[6] and Vandana S. Madke[7]

ABSTRACT

The physiological response of foliar sprays of chitosan (25, 50, 75 ,100 and 125 ppm) and IBA (25, 50, 75 ,100 and 125 ppm) on the chemical, biochemical and yield contributing parameters of pigeonpea cv.PKV-Tara was studied during *kharif* 2017-2018 at farm of Botany section, College of Agriculture, Nagpur. Experiment was laid out in RBD with three replications and eleven treatments. Spraying of chitosan and IBA was done two times i.e. on 45 and 65 DAS. Observations about chemical and biochemical parameters like leaf chlorophyll, N, P, K content in leaves, protein content in seed were also estimated. Observations on yield contributing parameters like 100 seed weight, number of pods plant^{-1}, number of seeds pod^{-1}, seed yield plant^{-1}, plot^{-1} were recorded. Foliar sprays of 25 ppm IBA followed by 50 ppm chitosan significantly enhanced chemical and biochemical parameters and yield contributing parameters when compared with control and rest of the treatments under study.

(Key words: Pigeonpea, chitosan, IBA, foliar application, morpho-physiological parameters, yield)

INTRODUCTION

Pulses are important constituent of Indian diet. It is an important grain legume of the semiarid region and tropics area and forms a significant component of the diet of vegetarians. According to binomial classification pigeonpea name as (*Cajanus cajan* L. Millsp.) is a important legume and belongs to family *Leguminoseae* and genus *cajanus*. *Cajanus* is derived from Malay word '*katschang'* or '*katjang'* meaning pod or bean. According to FAO pigeonpea is also known as Red gram, tur, arhar, dal (India). Pigeonpea having high drought tolerance and the ability to use residual moisture during the dry season make it an importance crop. It is often cross pollinated crop (20 to 70 %) with diploid chromosome number 2n=22. Pigeonpea is divided into two botanical varieties "*varflavr*" and "*var bicolor*". The cultivar of variety flavus are earlier maturing, shorter plants with yellow standard and green globrous pods which are light coloured in the peninsula. The cultivar of variety bicolor are perennial, late maturing large bushy plants with dorsal side of standard red or purple or streaked with these colours and hairy pods blotched with maroon or dark coloured or speckled when ripe.

The importance of legume ranged from food to fodder and also ornamentals. Legumes also play a vital role in biological nitrogen fixation. Green legume (pulses) are an important source of dietary protein, fiber and calories. Interest in this crop is growing in many countries because of its multiple uses as source of food, livestock fodder and also improves soil fertility. Pigeonpea is nutritionally important as it contains protein 22.3 %, fat 1.7 %, calcium 7.3 mg,thiamine 0.45 mg, riboflavin 0.19 mg, niacin 2.9 mg. Besides this they are also the sources of minerals and some vitamins

Plant growth regulators are substances when added in small amounts modify the growth of plant usually by stimulating or inhibiting part of the natural growth regulation. They are considered as new generation of agrochemicals after fertilizers, pesticides and herbicides. Plant growth regulators are capable of increasing yield by 100-200 per cent under laboratory conditions, 10 -15 per cent in the field conditions. Plant growth regulators like promoters, inhibitors or retardants play a key role in internal control mechanism of plant growth by interacting with key metabolic processes such as nucleic acid and protein synthesis. The most commonly used growth regulators in pigeonpea are IBA, chitosan, Ethrel, cycocel, salicyclic acid, IAA, GA_3 etc. are enhancing growth and productivity of crop plants.

1. Professor, Botany Section, College of Agriculture, Nagpur (MS), India
2. P.G. Student, Botany Section, College of Agriculture, Nagpur (MS), India
3. Assoc. Professor, Botany Section, College of Agriculture, Nagpur (MS), India
4,5, 6 and 7. Asstt. Professors, Botany Section, College of Agriculture, Nagpur (MS), India

MATERIALS AND METHODS

Considering the above fact present work was undertaken to study the response of chitosan and IBA on chemical, biochemical and yield contributing parameters. Experiment was laid out in randomized block design with eleven treatments and three replications. Plot size of individual treatment was gross 4.20 m x 4.40 m and net 3.0 m x 4.0 m. Seeds were sown at the rate of 20 kg ha^{-1} by dibbling method at spacing of 60 cm x 20 cm on 1st July 2017. Treatments comprised of control (T_1), 25 ppm chitosan (T_2), 50 ppm chitosan (T_3), 75 ppm chitosan (T_4), 100 ppm chitosan (T_5), 125 ppm chitosan (T_6), 25 ppm IBA (T_7), 50 ppm IBA (T_8), 75 ppm IBA(T_9), 100 ppm IBA(T_{10}), 125 ppm IBA (T_{11}). The foliar application of chitosan and IBA was given at two stages i.e. at 45 and 65 DAS on pigeonpea. Observations on chemical viz., N,P,K content in leaves and biochemical parameters viz., chlorophyll content in leaves and protain content in seeds were recorded at 45, 65, 85 and 105 DAS. Total chlorophyll content in dried leaves was estimated by colorimetric method as suggested by Bruinsma (1982). Nitrogen content in leaves was determined by micro-Kjeldhal's method as given by Somichi *et al.* (1972). Phosphorus content in leaves was determined by vandomolybdate yellow colour method as given by Jackson (1967). Potassium content in leaves was determined by flame photometer by di-acid extract method given by Jackson (1967). Nitrogen content in seed was determined by micro-Kjeldhal's method as given by Somichi *et al.* (1972) and reading was multiplied by 6.25 to get seed protein content.

Yield contributing parameters were recorded after harvesting. The crop was kept free from disease and pest during the growth period. Harvesting was undertaken after the crop attained maturity. Data were analysed by statistical method suggested by Panse and Sukhatme (1954).

RESULTS AND DISCUSSION

Chlorophyll content in leaves

Data clearly indicated that, the chlorophyll content was varied at 45 DAS. Significantly highest chlorophyll content was recorded in treatments 25 ppm IBA (T_7) and 50 ppm chitosan (T_3) followed by treatments 50 ppm IBA (T_8), 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) , 125 ppm chitosan (T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) in a descending mannar when compared with control (T_1) .

At this stage (65 DAS) the leaf chlorophyll content was varied from 0.956-1.311 in which treatments 25 ppm IBA (T_7) , 50 ppm chitosan (T_3) , 50 ppm IBA (T_8) and 75 ppm chitosan (T_4) increased chlorophyll content significantly than other treatments. Whereas, treatments 75 ppm IBA (T_9) and 100 ppm chitosan (T_5) also increased chlorophyll content. But treatments 125 ppm chitosan (T_6) , 100 ppm IBA (T_{10}), 25 ppm chitosan (T_2) , 125 ppm IBA (T_{11}) were found atpar with control (T_1) in chlorophyll content .

At 85 DAS chlorophyll content in leaves ranged from 1.111-1.357. The chlorophyll content was highest in treatments 25 ppm IBA (T_7) , 50 ppm chitosan (T_3) and 50 ppm IBA (T_8) over control (T_1) and rest of the treatments. Smilarly treatments 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) ,125 ppm chitosan (T_6) , 100 ppm IBA (T_{10}) and 25 ppm chitosan (T_2) were also increased chlorophyll content significantly. Treatment 125 ppm IBA (T_{11}) was found at par with control (T_1) in chlorophyll content.

At 105 DAS chlorophyll content was reduced than that of chlorophyll content at 65 DAS and 85 DAS. At 105 DAS maximum chlorophyll content was noted in treatment 25 ppm IBA (T_7) and 50 ppm chitosan (T_3) . The next best in order of merit were treatments 50 ppm IBA (T_8), 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) , 125 ppm chitosan (T_6) and 100 ppm IBA (T_{10}). But treatments 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) were found at par with control (T_1) in chlorophyll content at this stage of observation .

Shraiy and Hegazi (2009) conducted an experiment to study the effect of acetylsalicylic acid (ASA) @ 10 and 20 ppm, indole-3-bytric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisum sativum* L.). Application of ASA and IBA at 25 and 35 DAS significantly increased total chlorophyll in leaves.

Farouk and Amany (2012) reported that foliar application of chitosan @ 250 ppm under water stress conditions significantly enhanced chlorophyll content of cowpea plant.

Leaf nitrogen content

The best results related to leaf nitrogen content obtained at 45 DAS in treatments 25 ppm IBA (T_7) and 50 ppm chitosan (T_3) followed by treatments 50 ppm IBA (T_8),75 ppm chitosan (T_4) , 75 ppm IBA (T_9) 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) 125 ppm chitosan(T_6) , 100 ppm IBA (T_{10}), 25 ppm chitosan (T_2) . But treatment 125 ppm IBA (T_{11}) was found at par with control (T_1) in leaf nitrogen content (T_1).

The result obtained during investigation leaf nitrogen at 65 DAS was significantly enhanced by the treatments 25 ppm IBA (T_7), 50 ppm chitosan (T_3) , 50 ppm IBA (T_8). Next to these treatments the treatments 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5), 125 ppm chitosan(T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) also increased leaf nitrogen content significantly.Whereas treatment 125 ppm IBA (T_{11}) was found at par with control (T_1) in leaf nitrogen content.

At 85 DAS significantly highest leaf nitrogen content was observed in treatments 25 ppm IBA (T_7) , 50 ppm chitosan (T_3) followed by treatments 50 ppm IBA (T_8),75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) ,125 ppm chitosan (T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) when compared with control (T_1).

Nitrogen content at 105 DAS was decreased than that of 85 DAS observation but in these treatments 25 ppm

IBA (T_7) , 50 ppm chitosan (T_3) and 50 ppm IBA (T_8) were significantly increased nitrogen content over control (T_1) . Rest to the treatments viz.,75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5), 125 ppm chitosan(T_6), 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) also increased nitrogen content significantly over control except treatment 125 ppm IBA (T_{11}) .

Amin *et al*. (2013) tested two plant growth regulators putrescine and Indole-3-butyric acid (IBA) @ 25, 50 and 100 mg l^{-1} applied either alone or in combinations. Spraying of putrescine and IBA @ 100 mg l^{-1} significantly enhanced nitrogen of chickpea (*Cicer arientinum* L.).

Sharifa (2013) carried out a field experiment on common bean to study the effect of different concentrations of chitosan (100, 200 and 400 ppm) and found that foliar application of 200 ppm chitosan increased inorganic nitrogen content in leaves.

Leaf phosphorus content

Phosphorus is an important constituent of protoplasm and nucleic acid and protein also, it is essential for the formation of grain.

Data pertaining to phosphorus content in leaves were estimated at four stages of observations i.e. 45, 65, 85 and 105 DAS. Phosphorus has been recognized as an important environmental factor limiting crop growth and production. Significant results were recorded at all the stages of observations.

Data indicates that at 45 DAS treatments 25 ppm IBA (T_7) , 50 ppm chitosan (T_3) and 50 ppm IBA (T_8) were found superior over rest of the tretments in leaf phosphorus content. Similarly treatments 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) , 125 ppm chitosan (T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2), 125 ppm IBA (T_{11}) also increased phosphorus content significantly over control (T_1) .

At 65 and 85 DAS the highest value was recorded in treatment 25 ppm IBA (T_7). Similarly remaining treatments under study viz., 50 ppm chitosan (T_3), 50 ppm IBA (T_8) , treatments 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) ,125 ppm chitosan (T_6) 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) were also showed their significance over control (T_1) in phosphorus content.

At 105 DAS the best and significant results were obtained in treatments 25 ppm IBA (T_7), 50 ppm chitosan (T_3), 50 ppm IBA (T_8), 75 ppm chitosan (T_4) and 75 ppm IBA (T_9). Two treatments viz., 100 ppm chitosan (T_5) and 125 ppm chitosan (T_6) also increased leaf phosphorus content siginificantly over rest of the treatments and control. Treatments 100 ppm IBA (T_{10}), 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) could not achived their target and were found at par with control (T_1).

Amin *et al*. (2013) studied two plant growth regulators viz., putrescine and Indole-3-butyric acid (IBA) @ 25, 50 and 100 mg l^{-1}, applied either alone or in combinations. Spraying of putrescine and IBA @ 100 mg l^{-1} significantly increased phosphorus content of chickpea (*Cicer arientinum* L).

Deotale *et al.* (2016) applied putrescine and IBA (50, 75, 100, 125 and 150 ppm each) with one control on soybean and observed that two foliar sprays of 100 ppm putrescine and 100 ppm IBA at two stages ie. before flowering and 10 days after flowering were found to be most effective in enhancing phosphorus content in leaves.

Leaf potassium content

At 45 DAS leaf potassium content was significantly maximum in treatments 25 ppm IBA (T_7) , 50 ppm chitosan (T_3) and 50 ppm IBA (T_8) , followed by treatments 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) . 125 ppm chitosan(T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) when compared with control (T_1) .

It is evident from experiment at findings that at 65 and 85 DAS significantly maximum potassium content was noticed in treatment 25 ppm IBA (T_7) . Other treatments viz., 50 ppm chitosan (T_3) , 50 ppm IBA (T_8) , 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) , 125 ppm chitosan (T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) also enhanced potassium content significantly over control (T_1).

The trend indicate that significantly maximum potassium content at 105 DAS was noted in treatments 25 ppm IBA (T_7) , 50 ppm chitosan (T_3) and 50 ppm IBA (T_8) , followed by treatments 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) , 125 ppm chitosan (T_6) and 100 ppm IBA (T_{10}) . But treatments 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) were found at par with control (T_1) in potassium content .

Farouk and Amany (2012) observed that foliar application of chitosan @ 250 ppm under water stress conditions significantly increased inorganic potassium content of cowpea plant.

Amin *et al*. (2013) tested two plant growth regulators i.e. putrescine and Indole-3-butyric acid (IBA) @ 25, 50 and 100 mg l^{-1}, applied either alone or in combinations. Spraying of putrescine and IBA @ 100 mg l^{-1} significantly enhanced potassium content of chickpea (*Cicer arientinum* L.).

Protein content in seeds (%)

Data revealed that significantly higher protein content was observed in treatment 25 ppm IBA (T_7) , remaining treatments also showed significant and positive response [50 ppm chitosan (T_3), 50 ppm IBA (T_8) , 75 ppm chitosan (T_4) . 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) , 125 ppm chitosan(T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11})] when compared with control (T_1) .

Shraiy and Hegazi (2009) carried out an experiment to study the effect of acetylsalicylic acid (ASA) @ 10 and 20 ppm, indole-3-bytric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisum sativum* L.). Application of ASA and IBA at 25 and 35 DAS significantly increased protein content.

Sharifa (2013) formulated a field experiment on common bean to study the effect of different concentrations of chitosan (100, 200 and 400 ppm) and observed that foliar application of 200 ppm chitosan increased protein content.

Yield and yield contributing parameters

Grain yield and its related parameters in pigeonpea were influenced by the application of growth regulators which have different influence on the allocation of assimilates between vegetative and reproductive organs. In general crop yield depends on the accumulation of photo-assimilates during the growing period and the way they are partitioned between desired storage organs of plant. In present study, it is revealed that the application of plant growth regulators significantly increased the number of grains, 100 grain weight and finally grain yield determining components in pigeonpea.

Number of pods plant^{-1}

The highest number of pods plant^{-1} were recorded in treatment receiving 25 ppm IBA (T_7) . The range of pods plant^{-1} was 145.8 pods in control (T_1) to 256.60 pods in treatment 25 ppm IBA (T_7). Number of pods plant^{-1} also increased significantly in treatments 50 ppm chitosan (T_3) , 75 ppm chitosan (T_4) , 75 ppm IBA (T_9) , 100 ppm chitosan (T_5),125 ppm chitosan (T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) when compared with control (T_1) .

Shraiy and Hegazi (2009) studied the effect of acetylsalicylic acid (ASA) @ 10 and 20 ppm, indole-3-bytric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisum sativum* L.). Application of ASA and IBA at 25 and 35 DAS significantly increased number of pods plant^{-1}.

Mondal *et al.* (2013) tested different concentrations of chitosan viz., 0 (control), 25, 50, 75 and 100 ppm at 25 and 35 DAS. They observed that foliar application of chitosan @ 50 ppm on mungbean significantly increased number of pods plant^{-1} over control.

Number of seeds pod^{-1}

In general it can be said that foliar application of chitosan and IBA significantly enhanced number of seeds pod^{-1} when compared with control. Treatments 25 ppm IBA (T_7) , 50 ppm chitosan (T_3) and 50 ppm IBA (T_8) significantly increased number of seeds pod$^{-1.}$ Treatments 75 ppm chitosan (T_4), 75 ppm IBA (T_9) , 100 ppm chitosan (T_5) . 125 ppm chitosan (T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) also showed their significance over control (T_1) in respect of number of seed pod^{-1} .

Shraiy and Hegazi (2009) tried different concentrations of acetyl salicylic acid (ASA) @ 10 and 20 ppm, indole-3-bytric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisumsativum*L.). Application of ASA and IBA at 25 and 35 DAS significantly increased seeds number pod^{-1} over control.

Mondal *et al.* (2013) applied different concentrations of chitosan viz., 0 (control), 25, 50, 75 and 100 ppm at 25 and 35 DAS. They observed that foliar application of chitosan @ 50 ppm on mungbean significantly increased seeds pod^{-1} over control.

Test weight

It is evident from table that significantly maximum 100 seed weight was recorded in treatments 25 ppm IBA (T_7) followed by treatments 50 ppm chitosan (T_3) , 50 ppm IBA (T_8) , 75 ppm chitosan (T_4) and 75 ppm IBA (T_9). But treatments 100 ppm chitosan (T_5) and 125 ppm chitosan(T_6), 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) were found at par with control (T_1) in test weight .

Shraiy and Hegazi (2009) tested the impact of acetylsalicylic acid (ASA) @ 10 and 20 ppm, indole-3-bytric acid (IBA) @ 50 and 100 ppm and gibberellic acid (GA) @ 50 and 100 ppm on pea (*Pisum sativum* L.). Application of ASA and IBA at 25 and 35 DAS significantly enhanced 1000 seeds weight over control.

Wagh (2015) tested different concentrations of putrescine and IBA (0, 50, 75, 100, 125 and 150 ppm) on soybean sprayed at 30 and 45 DAS. He observed that two foliar sprays of putrescine and IBA @ 100 ppm significantly increased 100 seed weight.

Seed yield

Seed yield is the economic yield which is final result of physiological activities of plant. Economic yield is the part of biomass that is converted into economic product. (Nichiporovic, 1960).

Seed yield and its related parameters were influenced by the application of different growth regulators in pigeonpea which indicated that these chemicals have differential influence on the allocation of assimilates between vegetative and reproductive organs. In general, crop yield depends on the accumulation of photo-assimilates during the growing period and the way they are partitioned between desired storage organs of plant. In the present study, it can be inferred that the application of PGRs significantly increased the number of pods, 100-seed weight and finally seed yield plant^{-1}, plot^{-1} which are the most important yield determining components in pigeonpea .

The significantly maximum seed yield plant^{-1}, plot^{-1} were recorded in treatment 25 ppm IBA (T_7) followed by treatments 50 ppm chitosan (T_3) , 50 ppm IBA (T_8) , 75 ppm chitosan (T_4), 75 ppm IBA (T_9) and 100 ppm chitosan (T_5) . Remaining treatments 125 ppm chitosan (T_6) , 100 ppm IBA (T_{10}) , 25 ppm chitosan (T_2) and 125 ppm IBA (T_{11}) were found at par with control (T_1) .

Amin *et al.* (2013) studied the effect of two plant growth regulators putrescine and Indole-3-butyric acid (IBA) @ 25, 50 and 100 mg l^{-1} applied either alone or in combinations. Spraying of putrescine and IBA @ 100 mg l^{-1} significantly increased seed yield of chickpea (*Cicer arientinum* L.).

Rabbi *et al*. (2016) formulated an experiment to study the effect of chitosan (0, 25, 50, 75 and 100 ppm) on mungbean sprayed at 30 and 40 DAS. Results showed that application of chitosan @ 50 ppm significantly enhanced seed yield.

Thakare *et al.* (2019) also reported that foliar application of 25 ppm IBA and 50 ppm chitasan significantly enhanced yield of pigeonpea over control.

Table1. Effect of chitosan and IBA on chemical and biochemical parameters of pigeonpea

Treatments	Leaf chlorophyll content (mg g^{-1})				Leaf nitrogen content (%)				Leaf phosphorus content (%)				Leaf potassium content (%)				Seed protain content (%)
	45 DAS	65 DAS	85 DAS	105 DAS	45 DAS	65 DAS	85 DAS	105 DAS	45 DAS	65 DAS	85 DAS	105 DAS	45 DAS	65 DAS	85 DAS	105 DAS	
T_1 (Control)	0.754	0.956	1.111	0.413	2.049	2.203	2.373	2.376	0.300	0.796	0.616	0.632	0.615	0.456	0.617	0.641	15.22
T_2 (25 ppm Chitosan)	0.946	1.033	1.192	0.541	2.226	3.046	3.113	3.190	0.319	0.831	0.693	0.654	0.755	0.511	0.726	0.655	18.18
T_3 (50 ppm Chitosan)	1.059	1.217	1.328	1.066	2.596	3.804	3.916	3.761	0.364	0.912	0.811	0.776	0.916	0.583	0.871	0.791	24.17
T_4 (75 ppm Chitosan)	1.006	1.171	1.294	0.741	2.376	3.471	3.556	3.593	0.346	0.870	0.746	0.759	0.888	0.559	0.759	0.772	21.04
T_5 (100 ppm Chitosan)	0.987	1.114	1.253	0.717	2.325	3.316	3.406	3.550	0.330	0.862	0.725	0.713	0.860	0.537	0.737	0.731	19.93
T_6 (125 ppm Chitosan)	0.980	1.079	1.229	0.673	2.293	3.193	3.356	3.453	0.322	0.852	0.717	0.697	0.845	0.534	0.734	0.709	18.88
T_7 (25 ppm IBA)	1.078	1.311	1.357	1.192	2.686	3.873	4.146	3.976	0.367	0.947	0.908	0.786	0.924	0.605	0.892	0.799	25.35
T_8 (50 ppm IBA)	1.027	1.212	1.333	0.891	2.383	3.661	3.643	3.703	0.356	0.874	0.750	0.766	0.911	0.574	0.783	0.785	21.27
T_9 (75 ppm IBA)	0.998	1.148	1.275	0.718	2.376	3.363	3.413	3.573	0.344	0.863	0.733	0.747	0.868	0.547	0.747	0.758	19.98
T_{10} (100 ppm IBA)	0.963	1.043	1.197	0.647	2.262	3.176	3.291	3.256	0.320	0.839	0.714	0.667	0.834	0.521	0.731	0.663	18.67
T_{11} (125 ppm IBA)	0.866	0.981	1.147	0.476	2.063	2.836	2.816	2.706	0.314	0.814	0.684	0.642	0.716	0.488	0.709	0.646	18.07
SE (m) ±	0.0147	0.0518	0.019	0.057	0.033	0.082	0.106	0.111	0.0041	0.0054	0.0057	0.0141	0.0097	0.0041	0.0097	0.0060	0.324
CD at 5%	0.0436	0.1530	0.056	0.168	0.098	0.243	0.314	0.327	0.0120	0.0160	0.0168	0.0416	0.0288	0.0123	0.0286	0.0179	0.958

Table 2. Effect of chitosan and IBA on yield and yield contributing parameters of pigeonpea

Treatments	Number of pods plant^{-1}	Number of seeds pod^{-1}	Test weight (g)	Seed yield plant^{-1}(g)	Seed yield plot^{-1}(kg)
T_1 (Control)	145.58	3.31	9.16	12.25	1.225
T_2 (25 ppm Chitosan)	181.54	3.54	9.72	13.04	1.304
T_3 (50 ppm Chitosan)	246.47	3.93	11.81	16.51	1.651
T_4 (75 ppm Chitosan)	230.53	3.84	10.72	14.33	1.433
T_5 (100 ppm Chitosan)	208.43	3.73	10.05	14.07	1.407
T_6 (125 ppm Chitosan)	194.58	3.65	9.80	13.83	1.383
T_7 (25 ppm IBA)	256.60	4.00	12.89	17.88	1.788
T_8 (50 ppm IBA)	237.69	3.94	10.79	15.28	1.528
T_9 (75 ppm IBA)	222.47	3.75	10.67	14.17	1.417
T_{10} (100 ppm IBA)	188.44	3.63	9.75	13.54	1.354
T_{11} (125 ppm IBA)	161.48	3.53	9.73	13.02	1.302
SE (m) ±	0.558	0.041	0.308	0.613	0.062
CD at 5%	1.648	0.121	0.910	1.578	0.153

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