J. Soils and Crops 31 (1) 131-133, June 2021

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

IMPACT OF DIFFERENT CONCENTRATIONS OF CHITOSAN IN ENHANCEMENT OF YIELD AND YIELD CONTRIBUTING PARAMETERS IN GROUNDNUT

Kantilal B Chande[1], Rajesh D. Deotale[2], Puja R. Mate[3], Vandana B. Kalamkar[4] and A. D. Banginwar[5]

ABSTRACT

In order to evaluate the effect of chitosan at 0 (control), 25, 50, 75, 100 and 125 ppm field experiment was conducted at farm of agricultural Botany Section, College of Agriculture, Nagpur during *kharif* 2019-20 in RBD with four replications. The data showed that two foliar sprays of 100 ppm chitosan at 25 and 45 DAS significantly increased number of pods plant^{-1}, number of seeds pod^{-1}, 100 seed weight and seed yield plant^{-1}, plot^{-1} and ha^{-1}. Harvest index was also significantly increased by the same treatment.

(Key words: Groundnut, Chitosan, foliar application, yield, yield contributing parameters)

INTRODUCTION

Groundnut is one of the most important field legumes in India. Being an oil crop it plays an important role in country's agricultural economy, on account of its versatile use in domestic and industrial fields. Domestically it is used as a source of edible and cattle feed etc. It has greater importance in industry as it is one of main source of raw material for vanaspati industries.

The major groundnut producing countries of world are lndia, China, USA, Brazil, Senegal and West Africa. India ranks second in "production of groundnut after China. In India area under groundnut crop during 2018-19 was 41.42 million hectares with the production of 27.52 million tonnes having potentiality of yield was 1834 kg ha^{-1} (Anonymous, 2018). In Maharashtra total area under groundnut cultivation during 2018-19 was 24 million hectares, with the production of 16.57 million tonnes having average productivity of 1148 kg ha^{-1} (Anonymous. 2018). Vidarbha region contributes major share in area as well as production of groundnut. In Vidarbha total area under groundnut was 13.39 million hectares with the total production of about 8.88 million tonnes during the year 2018-19 (Anonymous, 2019).

Chitosan is a natural biopolymer modified from chitins which act as a potential bio stimulant and elicitor in agriculture. It is non-toxic, biodegradable and biocompatible which favours potentially broad application. It enhances the physiological response and mitigates the adverse effect of abiotic stresses through stress transduction pathway via secondary messenger. Chitosan treatment stimulates photosynthetic rate, stomatal closure through ABA synthesis; enhances antioxidant enzymes via nitric oxide and hydrogen peroxide signalling pathways, and induces production of organic acids, sugars, amino acids and other metabolites which are required for the osmotic adjustment, stress signalling, and energy metabolism under stresses. It is also known to form complexes with heavy metals and used as tool for phytoremediation and bioremediation of soil. Besides, this is used as antitranspirant compound through foliar application in many plants thus reducing water use and ensures protection from other negative effects. Based on such beneficial properties, chitosan is utilized in sustainable agricultural practices owing to changing climates.

MATERIALS AND METHODS

Field experiment was conducted in RBD with four replications and 6 treatments of chitosan (0, 25, 50, 75, 100 and 125 ppm) during year 2019-20. Gross plot size was 3.15 m x 2.20 m and net plot size was 2.10 m x 2.20 m with spacing of 45 cm x 10 cm. Spraying of chitosan was done at 25 and 45 DAS after sowing. Fertilizer dose was used *viz.,*25:75:30 NPK ha^{-1}. Observations on number of pods plant^{-1}, number of seeds pod^{-1}, 100 seed weight and seed yield plant^{-1}, plot^{-1} and ha^{-1} were recorded. Harvest index was calculated by the procedure suggested by Donald and Hamblin (1976). Per cent increase in yield over control by different treatments was also calculated.

1&3. P.G. Students,Agril. Botany Section, College of Agriculture, Nagpur
2. Professor,Agril. Botany Section, College of Agriculture, Nagpur
4. Sr. Res. Assistant ,Agril. Botany Section, College of Agriculture, Nagpur
5. Asstt.Professor,Agril. Botany Section, College of Agriculture, Nagpur

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

-

RESULTS AND DISCUSSION

Number of pods plant^{-1}

Number of pods plant^{-1} was significantly highest in treatment T_5 (100 ppm chitosan) followed by treatments T_4 (75 ppm chitosan) and T_3 (50 ppm chitosan) when compared with treatment T_1 (control) and rest of the treatments under study. Treatments T_2 (25 ppm chitosan) and T_6 (125 ppm chitosan) also showed their significance over treatment T_1 (control) in number of pods plant^{-1}.

Juan *et al.* (2018) studied the effect of quitomax (liquid formulation of chitosan 4 g l^{-1}) on cowpea plant. Foliar sprays of quitomax having concentrations 200, 400 and 600 mg ha^{-1} was applied. Significantly maximum pods plant^{-1} were noted by the application of quitomax @ 600 mg ha^{-1} in cowpea.

Deotale *et al.* (2019) studied effect of foliar sprays of chitosan (25, 50, 75, 100 and 125 ppm) on yield and yield contributing parameters of pigeonpea. They noted that 50 ppm chitosan significantly increased number of pods plant^{-1} in pigeonpea.

Number of seeds pod^{-1}

Number of seeds pod^{-1} was significantly highest in treatment T_5 (100 ppm chitosan) followed by treatments T_4 (75 ppm chitosan) and T_3 (50 ppm chitosan) when compared with treatment T_1 (control) and rest of the treatments under examination. However, treatments T_2 (25 ppm chitosan) and T_6 (125 ppm chitosan) were also found significantly superior over treatment T_1 (control) in number of seeds pod^{-1}.

Meshram *et al.* (2018) studied the effect of foliar application of chitosan (0, 25, 50, 75 and 100 ppm) on yield and yield contributing parameters of soybean. Study revealed that foliar sprays of chitosan @ 25 ppm significantly produced higher number of seeds pod^{-1} in soybean.

Deotale *et al.* (2019) estimated the effect of foliar application of chitosan on yield and yield contributing parameters of pigeonpea. Chitosan @ 25, 50, 75,100 and 125 ppm was applied at 45 and 65 DAS. They found significantly more number of seeds pod^{-1} in pigeonpea.

100 seed weight (g)

Treatment T_5 (100 ppm chitosan) exhibited significantly highest 100 seed weight followed by treatments T_4 (75 ppm chitosan), T_3 (50 ppm chitosan), T_2 (25 ppm chitosan) and T_6 (125 ppm chitosan) over treatment T_1 (control).

Mondal *et al.* (2013) examined the effect of foliar application of chitosan on growth and yield contributing parameters of maize. The concentrations of chitosan @ 0 (control), 50, 75, 100 and 125 ppm were sprayed three times @ 35, 50 and 65 days after sowing. Results revealed that foliar application of chitosan @ 125 ppm improved the 100 seed weight in maize.

Meshram *et al.* (2018) tested different concentrations of chitosan (0, 25, 50, 75 and 100 ppm) on yield and yield contributing parameters of soybean. Data showed significant increase in number of seeds pod^{-1} in soybean by the application of 25 ppm chitosan.

Seed yield plant^{-1}(g), plot^{-1}(kg), and ha^{-1}(q)

Seed yield is influenced by morpho-physiological parameters such as plant height, total dry matter production, leaf area and test weight which are considered as yield contributing parameters. Seed yield plant^{-1}, plot^{-1} and ha^{-1} are the combined effect of yield attributing characters and physiological efficiency of plant.

Source–sink relation contributes to the seed yield. It includes phloem loading at source (leaf) and unloading at sink (seed and pod) by which the economic part will be getting assimilates synthesized by photosynthesis. Partitioning of assimilate in the plant during reproductive development is important for flower, pods and seeds. Thus, crop yield can be increased either by increasing the total dry matter production or by increasing the proportion of economic yield (harvest index) or both (Gardner *et al*., 1988).

Significantly maximum seed yield plant^{-1}, plot^{-1} and hectare^{-1} was produced in treatmentT_5 (100 ppm chitosan) when compared with treatment T_1 (control) and rest of the treatments under study. Also treatments T_4 (75 ppm), T_3 (50 ppm chitosan), T_2 (25 ppm chitosan) and T_6 (125 ppm chitosan) were found significantly superior in a descending manner when compared with treatment T_1 (control) in production of seed yield plant^{-1}, plot^{-1} and hectare^{-1}. The positive effect of chitosan on plant growth may be credited to an increase in the key enzyme activities of nitrogen metabolism and increased photosynthesis which enhanced plant growth (Gornik *et al.* 2008; Mondal *et al.,* 2012). Chitosan applications significantly increased total carbohydrates accumulation in the fruits (Mawgoud *et al.,* 2010). These might be the reasons for increase in yield in the present study.

The increase in groundnut yield due to chitosan application may be due to its effect in stimulating physiological processes, improving vegetative growth, followed by the active translocation of photo assimilates from source to sink tissue (Sharifa and Abu Muniefah, 2013).

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

Deotale *et al.* (2019) studied the effect of foliar sprays of chitosan@ 25, 50, 75, 100 and 125 ppm on yield of pigeonpea. They reported that foliar application of 50 ppm chitosan significantly enhanced seed yield in pigeonpea over control and rest of the treatments under study.

Harvest index

Significantly maximum harvest index was calculated in treatment T_5 (100 ppm chitosan) when compared with treatment T_1 (control) and rest of the treatments under study. Also treatments T_4 (75 ppm), T_3 (50 ppm chitosan), T_2 (25 ppm chitosan) and T_6 (125 ppm chitosan) were found significantly superior in a descending manner when compared with treatment T_1 (control) in harvest index.

Harvest index is the proportion of biological yield represented by economic yield. It is the coefficient of effectiveness or the migration coefficient. Harvest index reflects the proportion of assimilate distribution between the economic and total biomass (Donald and Hamblin, 1976). Increase in harvest index might be the result of coordinated interplay of growth and development characters.

Meshram *et al.* (2018) tried different concentrations of chitosan (0, 25, 50, 75 and 100 ppm) on yield and yield contributing parameters of soybean. Data revealed that foliar spray of chitosan @ 25 ppm significantly increased harvest index in soybean.

Finally it is inferred that spraying of plants at 25 and 45 DAS with 100 ppm chitosan could be considered as the most suitable time and concentration to expect promising improvement regarding yield and yield contributing parameters of groundnut.

Table 1. Effect of chitosan on yield and yield contributing parameters of groundnut

Treatments	Number of pods plant^{-1}	Number of seeds pods^{-1}	100 seed weight (g)	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (kg)	Seed yield ha^{-1} (q)	Per cent increase in yield	Harvest index (%)
T_1 (Control)	18.59	1.77	39.20	5.50	0.550	12.22	—	29.09
T_2 (25 ppm chitosan)	20.80	2.13	42.15	6.71	0.671	14.91	22.00	31.94
T_3 (50 ppm chitosan)	21.80	2.16	42.75	7.36	0.736	16.35	33.81	32.35
T_4 (75 ppm chitosan)	22.80	2.18	43.17	7.49	0.749	16.64	36.18	34.67
T_5 (100 ppm chitosan)	24.21	2.22	43.62	8.31	0.831	18.46	51.09	38.01
T_6 (125 ppm chitosan)	20.55	2.10	41.32	6.19	0.619	13.75	12.52	31.45
SE (m) ±	0.070	0.020	0.930	0.0408	0.0034	0.0182	—	0.1150
CD at 5 %	0.204	0.059	2.759	0.1224	0.0101	0.0542	—	0.3450

REFERENCES

Anonymous, 2018. Ann. report 2017-18 website www.krishi.maharashtra.gov.in.

Anonymous, 2019. Ann. report 2018-19 website www.indiastat.com.

Deotale, R.D.,O.G. Thakare, P.V. Shende, S.R. Patil, S. R. Kamdi, M. P. Meshram and V.S. Madke. 2019.Impact of foliar sprays of chitosan and IBA on chemical, biochemical and yield contributing parameters of pigeonpea. J. Soils and Crops, **29** (2): 306-311.

Donald, C.M. and J. Hamblin, 1976. Growth and development in physiology of crop plants 2ndEd.Scientific publishers Jodhpur, pp.198-199.

Gardner, F. P., R. B. Pearce and R. L.Mitchell, 1988. Transport and partitioning in physiology of crop plants. 2nd Ed. Scientific. Publishers, Jodhpur. pp. 58-95.

Gornik, K., M. Grzesik and B.R. Duda, 2008. The effect of chitosan on rooting of grape vine cuttings and on subsequent plant growth under drought and temperature stress. J. Fruit Ornam. Plant Res. **16**: 333-343.

Juan, J.R., M.A. Ramírez-Arrebato, A.T. Rodríguez-Pedroso, L. Lara-Capistrán , L.G. Hernández-Montiel. 2018. Effect of quitomax on the indicators of growth, phenology and yield of cowpea (*Vigna unguiculata* L.) Biotecnia.**21**(1): 109-112.

Mawgoud, A.M.R., A.S. Tantawy, M.A. El-Nemr and Y.N. Sassine, 2010.Growth and Yield Responses of Strawberry Plants to Chitosan Application. European J. Sci. Res. **39**: 170-177.

Meshram, S. D., R. D. Deotale, K. H. Chute, G. N. Jadhav and G. A. Padghan, 2018. Morpho-physiological and yield responses of soybean to foliar sprays of chitosan and IBA. J. Soils and Crops **28**(1):121-127.

Mondal, M.M.A., M.A. Malek, A.B. Puteh, M.R. Ismail, M. Ashrafuzzaman and L. Naher, 2012. Effect of foliar application of chitosan on growth and yield in okra, Australian J. Crop Sci. **6** (5): 918-92.

Mondal, M.M.A., A.B. Puteh, N.C. Dafader,M.Y.Rafii and M. A. Malek, 2013.Foliar application of chitosan improves growth and yield in maize. J. Food Agric. & Environ. **11**(2):520-523.

Rabbi, F., M. Rahman, M.M.A. Mondal, S.K. Bhowal and A. Haque, 2016. Effect of chitosan application on plant characters, yield attributes and yield of mungbean. Res. J. Agri. and Environ. Manag. **5**(3) :95-100.

Sharifa, S. and Abu-Muriefah, 2013. Effect of chitosan on common bean (*Phaseolus vulgaris* L.) plants grown under water stress conditions. INTL. Res. J. Agric. Sci. and Soil Sci. **3**(6): 192-199.

Rec. on 15.10.2020 & Acc. on 27.10.2020