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Influence of plant growth regulators on yield and yield attributes of mungbean (*Vigna radiata* L. Wilczek)

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Abstract
The present investigation entitled "Influence of plant growth regulators on yield and yield attributes of mungbean (*Vigna radiata* L. Wilczek)" was conducted during *kharif* season, 2015 at the Student Instructional Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.), India in randomized block design with ten treatments, three replications and variety Narendra mung-1. The treatments were comprised of foliar spray of two plant growth regulators (PGRs) of different concentrations *viz*., Salicylic acid (50, 100, 150 and 200 ppm) and GA_3 (50, 100, 150 and 200 ppm) along with untreated control (distilled water spray) & spraying was done at 25 DAS. The observations were taken yield and yield attributes like number of clusters plant^{-1}, number of pods cluster^{-1}, number of pods plant^{-1} and pod length (cm). All the PGRs *viz*., salicylic acid and GA_3 induced positive influence on yield and yield attributes in plants but the foliar spray of salicylic acid @ 150 ppm at 25 DAS was found more profound among all treatments.

Keywords: Mungbean, GA_3, salicylic acid, PGR's

Introduction

Pulses stand a strategic position in the agriculture economy of our country. They contain high percentage of quality protein three times more than cereals. Pulses contain vitamin B, minerals and also contain a certain quality fibers, which is desirable in human diet because of medical consideration. Pulse crops enrich the soil through symbiotic nitrogen fixation from atmosphere. Besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and thus, play a vital role in sustainable agriculture. Mungbean (*Vigna radiata* L. wilezek) is also known as green gram, it is an important pulse crop of India and grown in *Rabi* (South India), *Kharif* and *Zaid* seasons. It is green with husk and yellow when dehusked. The beans are small, ovoid in shape and green in color. Average area under mung bean in India is 3.02 m ha with a production of 1.50 m tones and productivity 298.0 kg/h. In U.P., it occupies 88.0 ha area with production of 46.0 tones and productivity 523.0 kg/h. (Anonymous, 2015-16) [1].

Plant growth regulators can improve the physiological efficiency including photosynthetic ability and thereby helping in effective flower formation, fruit and seed development and ultimately enhance productivity of the crops (Solamani *et al*. 2001) [10]. Foliar feeding of plants can effectively supplement soil fertilization. It has been found that element foliar application is more influential compared to soil application (Kazemi 2013) [6]. Seeding date is an important factor affecting growth and yield traits which vary depending on the environmental conditions associated with the agriculture, particularly temperature, light and humidity which determines the best time for Mung bean cultivation. Growth is affected negatively or positively by plant growth regulators including salicylic acid which works to improve the productivity of crop through its effect on the important physiological process in the plant such as growth, photosynthesis, flowering and drought resistance.

Salicylic acid is a phenolic phytohormone and is found in plants with roles in plant growth and development, photosynthesis, transpiration, ion uptake and transport. Salicylic acid also induces specific changes in leaf anatomy and chloroplast structure. Salicylic acid (SA) is an endogenous plant growth of phenolic nature that possesses an aromatic ring with a hydroxyl group or its hormone plays a vital role in plant growth, ion uptake and transport (Hayat *et al.* 2010). Enhanced germination and seedling growth were recorded in wheat, when the grains were subjected to pre-sowing seed-soaking treatment in salicylic acid (Shakirova 2007) [9].

However, numerous studies have demonstrated that the effect of exogenous SA depends on various factors, including the species and developmental stage, the mode of application and the concentration of SA used (Vanacker *et al.* 2001; Horvth *et al.* 2007) [12]. Fariduddin *et al.* (2003) [3] also eported that the dry matter accumulation was significantly increased in *Brassica juncea*, when lower concentrations of salicylic acid were sprayed. However, higher concentrations of salicylic acid had an inhibitory effect. Khodary (2004) [7] observed a significant increase in growth characteristic, pigment contents and photosynthetic rate in maize, sprayed with salicylic acid.

Gibberellic acid (GA_3) is an important PGR that affects plant growth and development by induc-ing metabolic activities and regulating nitrogen uti-lisation (Sure *et al.* 2012) [11]. It also plays a significant role in seed germination, endosperm mobilisation, stem elongation, leaf expansion, reducing the matu-ration time and increasing flower and fruit set and their composition (Roy & Nasiruddin 2011) [8]. GA_3 delays senescence, improves growth and develop-ment of chloroplasts, and intensifies photosynthetic efficiency which could lead to increased yield (Yuan & Xu 2001) [13]. The applications of gibberellins increase the seed germination percentage by attributing the fact that they increase the amino acid content in embryo and cause release of hydrolytic enzyme required for digestion of endospermic starch when seeds renew growth at germination.

Materials and Methods

The present investigation was carried out in the Student Instructional Farm (SIF) Narendra Deva University of Agriculture & Technology, Kumarganj Faizabad (U.P.) under Normal condition during *Kharif* season of 2015. The hormonal solutions were prepared by dissolving in organic solvent then maintained the desired concentration in distilled water. Solution of salicylic acid (50, 100, 150 and 200 ppm) and GA_3 (50, 100, 150 and 200 ppm) were prepared at 25 days after sowing and sprayed on the foliage of plants with the help of hand sprayer "Ganesh" as per treatment. While in untreated control distilled water was sprayed.

Results and Discussions

Data pertaining to number of clusters plant^{-1} presented in Table 1. The mean data revealed a significant increase in number of clusters plant^{-1} with respect to control. The maximum number of clusters plant^{-1} was recorded with foliar spray of salicylic acid 150 ppm (6.33clusters plant^{-1}) followed by foliar spray of GA_3 150 ppm (6.28clusters plant^{-1}) was recorded over other treatments. Whereas, minimum clusters plant^{-1}was recorded with foliar spray of GA_3 50 ppm (5.50 clusters plant^{-1}) over control.

The mean data on number of pods cluster^{-1} have been presented in Table 1. Significantly higher number of pods cluster^{-1} (7.94 pods cluster^{-1}) was counted with foliar spray of salicylic acid 150 ppm followed by foliar spray of salicylic acid 200 ppm (7.32pods cluster^{-1}) was recorded over control. On the other hand, minimum number of pods cluster^{-1} was recorded with foliar spray of GA_3 50 ppm (6.12 pods cluster^{-1}) as compared to control.

Observation with respect to number of pods plant^{-1} showed in Table 1. Significantly higher number of pods plant^{-1} (50.26 pods plant^{-1}) was counted with foliar spray of salicylic acid 150 ppm as compared to others treatments including control (26.99 pods plant^{-1}). $GA_3$150 ppm also recorded higher number of pods plant^{-1} (45.84 pods plant^{-1}).

Data with recorded on pod length have been presented in Table 1. All the treatment showed significantly increased in pod length over control. The mean data revealed that the maximum increased in pod length was recorded with foliar spray of GA_3 150 ppm (7.42 cm) followed by foliar spray of GA_3 200 ppm (7.38 cm) over control. On the other hand, minimum increase in pod length was recorded of foliar spray of salicylic acid 50 ppm (67.04 cm) as compared to control.

Yield is the culmination of several comprehensive phases which starts at germination and end at harvest, encompassing through shoot growth, leaf development, photosynthesis, flowering, pollination and seed set. Better vegetative growth of a crop is largely responsible for higher seed yield because number of photosynthesizing sites i.e. number of vegetative branches is affected by initial growth stage. Two sequential steps are necessary for a mung bean plant to produce pods, a sink of pollination pods capable of further development must be created and this must be supplied with photosynthates over subsequent period of development. The above higher yield attributes obtained with foliar spray salicylic acid 150ppm which may be because of maximum net photosynthetic rate in leaves and better translocation of photosynthates and metabolites (nutrients etc.). Though, the way of various physiological mechanism involves in the plant with foliar spray of GA_3 150 ppm also played a significant role in enhancing above yield attributes up to some extent. The present finding is in accordance with Costa *et al.* (2011) [2] in kiwi fruits.

Table 1: Effect of plant growth regulators on yield attributes of mungbean during *kharif* season

Treatments	Number of clusters plant^{-1}	Number of pods cluster^{-1}	Number of pods plant^{-1}	Pod length (cm)
T_1 : Control	4.76	5.67	26.99	6.78
T_2 : Salicylic acid 50 ppm	5.54	6.53	36.18	7.04
T_3 : Salicylic acid 100 ppm	6.04	7.08	42.76	7.20
T_4 : Salicylic acid 150 ppm	6.33	7.94	50.26	7.37
T_5 : Salicylic acid 200 ppm	6.13	7.32	44.87	7.22
T_6 : GA_3 50 ppm	5.50	6.12	33.66	7.10
T_7 : GA_3 100 ppm	5.92	6.67	39.49	7.26
T_8 : GA_3 150 ppm	6.28	7.30	45.84	7.42
T_9 : GA_3 200 ppm	6.04	7.22	43.61	7.38
SEm ±	**0.04**	**0.07**	**2.21**	**0.05**
CD at 5%	**0.12**	**0.20**	**6.63**	**0.15**

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