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IMPACT OF GROWTH RETARDENTS (MH AND TIBA) ON CHEMICAL AND BIOCHEMICAL PARAMETERS AND YIELD OF MUNGBEAN (Vigna radiata L.)

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Abstract:
A field experiment was conducted during kharif 2014-2015 at Botany Section, College of Agriculture, Nagpur (M.S) India. In the present study an attempt has been made to verify the effects of growth retardants MH and TIBA with different concentrations. Seven concentrations (50, 75, 100, 125, 150, 175 and 200 ppm) of MH and TIBA with one control were tested as foliar sprays. Foliar application of 100 ppm MH followed by 50 ppm TIBA at 25 and 35 DAS significantly enhanced total chlorophyll, nitrogen, phosphorus and potassium contents in leaves and protein content in seeds when compared with control and other treatments under study. But highest input : output ratio was observed by the foliar application of 100 ppm MH (1:2.37) followed by 50 ppm MH (1:2.08) and 50 ppm TIBA (1:2.06).
Keywords: Mungbean, MH, TIBA, chemical and biochemical parameters and yield

Introduction

Green gram is one of the thirteen food legumes grown in India after chickpea and pegionpea. It ranks third among all pulses grown in India after chickpea and pigeonpea. India is the largest producer and consumer of the pulses in the world, accounting for 33 per cent of words area and 24 per cent of words production. It is important legumes crop characterise by relative high content of protein (22 per cent). It also having 1.3 per cent fat, 56.72 to 70 per cent carbohydrates and 3.5 per cent minerals. It is traditionally consume after processing in to various products. The plant growth regulators are compounds that as chemical signals, controlling the plant development. They normally bind to respecter to plant, triggering a series of cellular changes which may affects the inhition or modification of tissue and organs (Taiz and Zeiger, 2009). The growth reducers are compounds that changes several plant characteristics. It enhances chlorophyll content. Growth retardant like maleic hydrazide increases endogenous ethylene level with trigger metabolic processes and affects the C: N ratio in plants in term stimulating flowers, fruit set and sex ratio thereby yield (Rise,1985). Similarly TIBA a synthetic growth regulator is used for checking excessive vegetative growth and loading tendency, reducing abscission of flower and immature pods and for modification crop canopy to improve the productivity of crop. It has also been suggested that the application of growth retardant increase availability of assimilates i.e., hormone directed translocation of photosynthests, which in turn may causes prolong chlorophyll synthesis (Stodder 1965). It was also known that growth hormone increases the uptake of nutrients from soil and also increases metabolic activity in plant cell (Sagare and Napahade, 1987). Hence, the objective of this study was to evaluate the effect of different concentrations of two growth reducers i.e., MH and TIBA on the mungbean during kharif 2014.

Material and Methods

A field experiment was conducted during kharif season of 2014 at research farm of Botany section, Agriculture College Nagpur, to find out the effect of seven levels (50, 75, 100, 125, 150, 175 and 200 ppm) of growth retardants MH and TIBA with one control. The experimental design was RBD comprised of three replications having fifteen treatments. Two foliar sprays of various treatments were given at 25 and 35 DAS. Observations on total chlorophyll content, nitrogen, phosphorus, potassium content in leaves and protein content in seeds were taken at 40 and 55 DAS. Total chlorophyll content in leaves was estimated by colorimetric method as suggested by Bruinsma (1982). Nitrogen content in leaves was determined by micro-kjeldhalâ€™s method as given by Somichi et al. (1972). 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-kjeldhalâ€™s method as given by Somichi et al. (1972) and same was converted in to crude protein by multiplying â€˜Nâ€™ per cent with factor 6.25. Seed yield plant-1 and ha-1 were also recorded..

Result and Discussion

Leaf chlorophyll content At 40 DAS all the treatments showed their significance in leaf chlorophyll content and significantly maximum leaf chlorophyll content was noticed with the foliar application of 100 ppm MH (T4) followed by foliar application of 50 ppm TIBA (T9) and 125 ppm MH (T5) when compared with control (T1) and rest of the treatments under study. Next to these treatments foliar application of 150 ppm MH (T6), 175 ppm MH (T7) and 75 ppm TIBA (T10) in a descending manner also significantly increased leaf chlorophyll content when compared with control (T1) and rest of the treatments. Remaining treatments were found at par with treatment T1 (control). At 55 DAS significantly maximum leaf chlorophyll content was noticed with the foliar application of 100 ppm MH (T4) when compared with control (T1) and rest of the treatments under study. Similarly foliar application of 50 ppm TIBA (T9), 125 ppm MH (T5), 150 ppm MH (T6), 175 ppm MH (T7), 75 ppm TIBA (T10), 100 ppm TIBA (T11), 200 ppm MH (T8), 75 ppm MH (T3), 125 ppm TIBA (T12) and 150 ppm TIBA (T13) were also increased leaf chlorophyll content when compared with control (T1) and rest of treatments under observation. While, treatments T2 (50 ppm MH), T14 (175 ppm TIBA) and T15 (200 ppm TIBA) were found at par with treatment T1 (control). There has been significant increase in chlorophyll content in treatments receiving with growth retardants. As a result, leaves of plants treated with growth retardants has much darker than those of untreated plants. This finding is in conformity with that of Cathey (1964) who opined that growth retardants in addition to the inhibition of cell division caused induction of granna and initiated the development of chloroplasts. It has also been suggested that the application of growth retardants increased the availability of assimilates i.e. hormone directed translocation of photosynthates, which in turn may cause prolonged chlorophyll synthesis (Stoddar, 1965). The increase in chlorophyll content as a result of hormones application might be due to better assimilation of nutrients from soil because of which there was more synthesis of chlorophyll in leaves. Plant hormones are known to influence the nutrient uptake by the plants. Increased uptake of nitrogen, magnesium and other elements which are directly and indirectly in the synthesis of chlorophyll might be responsible for its increased synthesis in plant leaves. Growth retardants mainly prevent Leaves expansion, making leaves thicker and greener which might be the reason for higher chlorophyll content in treated plants. Baldev and Sinha (1974) reported that foliar spray of TIBA increased leaf chlorophyll. Carvalho et al. (2013) studied the effects of three growth reducers on the sweet sorghum development. The treatments were control (water), maleic hydrazide @ 1440 ppm, paclobutrazol @ 1500 ppm and chlormequat @ 500 ppm. The sorghum development was evaluated by biometric parameters, relative chlorophyll content and potential of juice production. These compounds also increased the relative chlorophyll content (22.15 to 29.54%). Sawant (2014) observed that two foliar sprays of TIBA @ 50 ppm at 25 and 40 DAS significantly enhanced leaf chlorophyll content as compared to control in chickpea. Leaf nitrogen content At 40 DAS significantly maximum leaf nitrogen content was recorded with the foliar application of 100 ppm MH (T4) over control. Next to this treatments foliar application of 50 ppm TIBA (T9), 125 ppm MH (T5), 150 ppm MH (T6), 175 ppm MH (T7), 75 ppm TIBA (T10), 100 ppm TIBA (T11) and 200 ppm MH (T8) were also increased leaf nitrogen content in descending manner as compared to T1 (Control) and rest of the treatments. While, treatments T3 (75 ppm MH), T12 (125 ppm TIBA), T13 (150 ppm TIBA), T2 (50 ppm MH), T14 (175 ppm TIBA), and T15 (200 ppm TIBA) were found at par with treatment T1 (control). At 55 DAS significantly maximum leaf nitrogen content was recorded with the foliar application of 100 ppm MH (T4) over control. Similarly foliar application of 50 ppm TIBA (T9), 125 ppm MH (T5), 150 ppm MH (T6), 175 ppm MH (T7), 75 ppm TIBA (T10), 100 ppm TIBA (T11), 200 ppm MH (T8), 75 ppm MH (T3), 125 ppm TIBA (T12), 150 ppm TIBA (T13), 50 ppm MH (T2) and 175 ppm TIBA (T14) were also increased leaf nitrogen content in a descending manner when compared with control (T1) and rest of the treatments under observation. While, treatment T15 (200 ppm TIBA) was found at par with treatment T1 (control). The inferences drawn from the data, it is clear that leaf nitrogen content was gradually increased upto 40 DAS and reduced thereafter, at 55 DAS. The decrease in nitrogen content might be due to fact that younger leaves and developing organs, such as seeds act as strong sink demand and may draw heavily nitrogen from older leaves. (Gardner et al.,1988). Results recorded by Poonkodi (2003) also stated that decrease in nitrogen content at later stage might be due to translocation and utilization of nutrient for flower and pod formation. At the vegetative period, physiological and metabolic activities are at higher rate and this might be the reason for increase in uptake of nitrogen content from soil at early stage of crop growth. Shanmugam and Muthuswamy (1974) conducted an experiment on Chrysanthemum indicum plants, receiving supplementary light and spread with GA, MH and TIBA or CCC at various rates. All long day treatments increased foliar N, K, Ca and Carbohydrate. N was greater in plants treated with CCC or TIBA and GA. Sawant (2014) investigated the influence of foliar sprays of growth retardant TIBA (25, 50, 75, 100, 125 and 150 ppm) on chemical and biochemical and yield of chickpea cv. Jaki-9218. Data revealed that two foliar sprays of TIBA @ 50 ppm at 25 and 40 DAS significantly enhanced nitrogen content in leaves as compared with control. Leaf phosphorus content Data observed significant variation at all the stages of observations viz., 40 and 55 DAS. Trend of phosphorus content in leaves was found similar at both the stages of observations. Among the treatments T4 (100 ppm MH) recorded maximum leaf phosphorus at all the stages when compared with control (T1) and other treatments under study. Next to this treatments foliar application of 50 ppm TIBA (T9) was also increased leaves phosphorus content significantly when compared with control and rest of the treatments. Similarly foliar application of 125 ppm MH (T5), 150 ppm MH (T6), 175 ppm MH (T7), 75 ppm TIBA (T10), 100 ppm TIBA (T11), 200 ppm MH (T8), 75 ppm MH (T3) and 125 ppm TIBA (T12) were found superior over control (T1) and rest of the treatments. While, treatments T13 (150 ppm TIBA), T2 (50 ppm MH), T14 (175 PPM TIBA) and T15 (200 ppm TIBA) were found at par with T1 (control). It is evident from the data that phosphorus content in leaves was increased gradually up to 40 DAS and decreased at 55 DAS. It might be because of translocation of leaf phosphorus and itâ€™s utilization for development of food storage organ. It was also known that growth hormone increases the uptake of nutrients from soil and also increases metabolic activities in the plant cell (Sagare and Naphade, 1987). An experiment was conducted by Sawant (2014) to evaluated the effect of foliar sprays of growth retardant TIBA (25, 50, 75, 100, 125, 150 ppm) on chemical and biochemical parameters of chickpea cv. Jaki-9218. Two foliar sprays of TIBA @ 50 ppm at 25 and 40 DAS significantly enhanced phosphorus content in leaves when compared with control and rest of the treatments. Leaf potassium content At 40 DAS significantly maximum leaf potassium content was noticed with the foliar sprays of 100 ppm MH (T4). Next to this treatment foliar application of 50 ppm TIBA (T9) significantly increased leaf potassium content when compared with control (T1) and rest of the treatments under study. Similarly foliar application of 50 ppm TIBA (T9), 125 ppm MH (T5), 150 ppm MH (T6), 175 ppm MH (T7), 75 ppm TIBA (T10), 100 ppm TIBA (T11) and 200 ppm MH (T8) were also increased leaf potassium content when compared with control (T1) and rest of treatments under observation. Treatments T3 (75 ppm MH), T12 (125 ppm TIBA), T13 (150 ppm TIBA), T2 (50 ppm MH), T14 (175 ppm TIBA), and T15 (200 ppm TIBA) were found at par with treatment T1 (control). At 55 DAS significantly maximum leaf potassium content was recorded with the foliar application of 100 ppm MH (T4). Next to this treatment foliar application of 50 ppm TIBA (T9), 125 ppm MH (T5), 150 ppm MH (T6), 175 ppm MH (T7), 75 ppm TIBA (T10), 100 ppm TIBA (T11), 200 ppm MH (T8) and 75 ppm MH (T3) significantly increased leaf potassium content when compared with control (T1) and rest of the treatments under observation. But treatments T12 (125 ppm TIBA), T13 (150 ppm TIBA), T2 (50 ppm MH), T14 (175 ppm TIBA), and T15 (200 ppm TIBA) were found at par with treatment T1 (control). From given data, it was observed that potassium content was increased at 40 DAS but thereafter, at 55 DAS it was decreased gradually. The decrease in potassium content at advance stage might be due to diversion of potassium towards developing part i.e. pod of the green gram crop. Shanmugam and Muthuswamy (1974) conducted an experiment on Crysanthemum indicum plants, receiving supplementary light and spread with GA, MH and TIBA or CCC at various rates. All long day treatments increased foliar N, K, Ca and Carbohydrate. K was greater in plants treated with CCC or TIBA and GA. Carbohydrate was increased by CCC and TIBA while reduced by MH and GA. Sawant (2014) study the effect of foliar sprays of growth retardant TIBA with differents concentrations (25, 50, 75, 100, 125, 150, 175 ppm) with one control at 25 and 40 DAS on chickpea cv. Jaki-9218. Foliar application of TIBA @ 50 ppm significantly enhanced leaf potassium content over control and rest of the treatments. Protein content in seed The maximum seed protein were recorded with the foliar application of 100 ppm MH (T4) followed by foliar application of 50 ppm TIBA (T9), 125 ppm MH (T5), 150 ppm MH (T6) and T7 (175 ppm MH) when compared with control (T1) and rest of the treatments. While, treatmentsT10 (75 ppm TIBA), T11 (100 ppm TIBA), T8 (200 ppm MH), T3 (75 ppm MH), T12 (125 ppm TIBA), T13 (150 ppm TIBA), T2 (50 ppm MH), T14 (175 ppm TIBA), and T15 (200 ppm TIBA) in a descending manner were found at par with treatment T1 (control). Nitrogen is the constituent of protein. Hence, increase in nitrogen content ultimately resulted in the increase in protein content in seeds of green gram in the present investigation.Green gram plants have high N requirement for seed production. Major part of N is accumulated in the seed during pod filling stage. Nitrogen is key component in mineral fertilizers and has more influence on plant growth, appearance and fruit production / quality than any other element. It affects the absorption and distribution of other essential elements. Foliar application of MH and TIBA increases the uptake and availability of nutrients and its further assimilation for biosynthesis of protein. This might be the reasons for increased protein content in seed in the present investigation. Suryawanshi et al. (2013) tried foliar application of CCC (500 ppm) and MH (100 ppm) at 45, 50, 55 and 60 DAS on mung bean. Foliar application of growth regulators at advanced growth stage was more effective in improvement of seed quality parameters viz., protein and carbohydrate. Sawant (2014) reported that two foliar sprays of 50 ppm TIBA on chickpea recorded highest protein content in seed when compared with control and rest of the treatments. Seed yield plant-1 (g) and ha-1 (kg) Significantly maximum seed yield plant-1, ha-1 were recorded with the foliar application of 100 ppm MH (T4) followed by 50 ppm TIBA (T9). Next to these treatments, treatments T5 (125 ppm MH), T6 (150 ppm MH), T7 (175 ppm MH), T10 (75 ppm TIBA), T11 (100 ppm TIBA), T8 (200 ppm MH), T3 (75 ppm MH), T12 (125 ppm TIBA), T13 (150 ppm TIBA), T2 (50 ppm MH), T14 (175 ppm TIBA) and T15 (200 ppm TIBA) were also recorded maximum seed yield plant-1, plot-1 when compared with the treatment T1 (control). The highest input : output ratio was observed by the foliar application of 100 ppm MH (1:2.37) followed by 50 ppm MH (1:2.08) and 50 ppm TIBA (1:2.06). Increase in seed yield with growth retardant treatment may be attributed to reduction in plant height which was found to be useful in increase the efficiency of translocations of food material towards seed filling, Similarly application of growth retardant may also enhance the chlorophyll content of leaf which helps to increase the functional life of the source for a longer period leading to improve partitioning efficiency and increases productivity (Kashid et al., 2010). Ries (1985) opined that the application of growth retardant like maleic hydrazide increased the endogenous ethylene level which triggered metabolic processes and affected the C:N ratio in plants, in trun stimulating flowering, fruit set, sex ratio and thereby yield. TIBA (2,3,5-triiodo benzoic acide), a synthetic growth regulator is used for checking the excessive vegetative growth and lodging tendency , reducing the abscission of flowers and immature pods and for modification of crop canopy to improve the productivity of crops. Applications of TIBA induce greater growth, yield and yield attributes of various economically important crop plants viz., soybean, groundnut and cotton (Chung and Kim, 1989 and Jahan 1998, Djanaguiraman et al,. 2005 respectively). Kashid et al. (2010) studied the effects of maleic hydrazide (100, 200 and 300 ppm), TIBA (25, 50 and 75 ppm), cycocel (chlormequat; 500, 1000 and 1500 ppm) and mepiquat chloride [mepiquat] (1000, 1500 and 2000 ppm) applied as foliar spray at 40 days after sowing on the performance of sunflower (hybrid KBSH-1) under irrigated conditions. The seed yields obtained with mepiquat chloride (2000, 1500 and 1000 ppm), cycocel (1500, 1000 and 500 ppm), TIBA (75 ppm) and MH (300 ppm) were higher than those obtained with the control. Suryawanshi et al. (2013) investigated the effect of foliar spray of CCC (500 ppm) and MH (100 ppm) at 45, 50, 55 and 60 DAS on yield of mung bean. The foliar application of growth regulators significantly enhanced yield. Adam and Jahan (2014) evaluated the effect of different concentrations of TIBA (0, 20, 50, 100, 150 ppm) were spray at the age of 30 days after sowing. Results indicated that application of TIBA @ 20 mg l-1 significantly increased dry matter plant-1 and yield contributing characters viz., yield plant-1 and yield hectare-1. Increase in yield plant-1 and yield hectare-1 following 20 mg l-1 TIBA was 22.60 and 22.80% respectively over the control of mung.

Table 1. Effect of growth retardants (MH and TIBA) on chemical and biochemical parameters and yield of mungbean

Treatments	Leaf chlorophyll content (mg g $^{-1}$)		Leaf nitrogen content (%)		Leaf phosphorus content (%)	
	40 DAS	55 DAS	40 DAS	55 DAS	40 DAS	55 DAS
T_1 (Control)	1.32	1.13	1.83	1.06	0.50	0.46
T_2 (50ppm MH)	1.40	1.32	2.01	1.46	0.56	0.52
T_3 (75ppm MH)	1.49	1.42	2.16	1.79	0.62	0.56
T_4 (100ppm MH)	1.96	1.80	3.73	2.93	0.86	0.77
T_5 (125ppm MH)	1.73	1.57	2.48	2.03	0.73	0.65
T_6 (150ppm MH)	1.70	1.56	2.40	2.00	0.70	0.62
T_7 (175ppm MH)	1.68	1.51	2.36	1.96	0.70	0.60
T_8 (200ppm MH)	1.49	1.42	2.21	1.80	0.64	0.57
T_9 (50 ppm TIBA)	1.83	1.66	2.56	2.16	0.78	0.71
T_{10} (75 ppm TIBA)	1.60	1.49	2.33	1.94	0.67	0.59
T_{11} (100 ppm TIBA)	1.53	1.46	2.30	1.86	0.67	0.58
T_{12} (125 ppm TIBA)	1.46	1.40	2.10	1.68	0.60	0.56
T_{13} (150 ppm TIBA)	1.42	1.37	2.10	1.53	0.58	0.53
T_{14} (175 ppm TIBA)	1.37	1.30	1.96	1.30	0.56	0.50
T_{15} (200 ppm TIBA)	1.32	1.30	1.91	1.21	0.53	0.48
SE(m) ±	0.080	0.075	0.122	0.097	0.034	0.030
CD at 5%	0.233	0.217	0.354	0.280	0.098	0.088

Table 1. Continued

Treatments	Leaf potassium content (%)		Seed protein content (%)	Seed yield plant^{-1} (g)	Seed yield ha^{-1} (q)	Input : Output ratio
	40 DAS	55 DAS				
T_1 (Control)	0.58	0.52	20.63	1.55	5.20	1.78
T_2 (50ppm MH)	0.62	0.58	21.32	2.15	7.19	2.08
T_3 (75ppm MH)	0.67	0.66	21.61	2.23	7.45	2.00
T_4 (100ppm MH)	0.99	0.86	23.80	2.85	9.50	2.37
T_5 (125ppm MH)	0.82	0.77	22.39	2.43	8.12	1.90
T_6 (150ppm MH)	0.80	0.75	22.30	2.40	8.01	1.76
T_7 (175ppm MH)	0.77	0.74	22.17	2.36	7.90	1.64
T_8 (200ppm MH)	0.70	0.68	21.73	2.30	7.69	1.51
T_9 (50 ppm TIBA)	0.91	0.80	22.98	2.65	8.87	2.06
T_{10} (75 ppm TIBA)	0.73	0.70	22.01	2.34	7.82	1.56
T_{11} (100 ppm TIBA)	0.73	0.69	21.88	2.32	7.77	1.36
T_{12} (125 ppm TIBA)	0.65	0.61	21.59	2.20	7.37	1.15
T_{13} (150 ppm TIBA)	0.64	0.60	21.39	2.18	7.28	1.03
T_{14} (175 ppm TIBA)	0.62	0.57	21.23	2.13	7.13	0.91
T_{15} (200 ppm TIBA)	0.60	0.56	21.20	2.11	7.03	0.83
SE(m) ±	0.037	0.035	0.527	0.121	0.397	-
CD at 5%	0.108	0.103	1.523	0.349	1.147	-

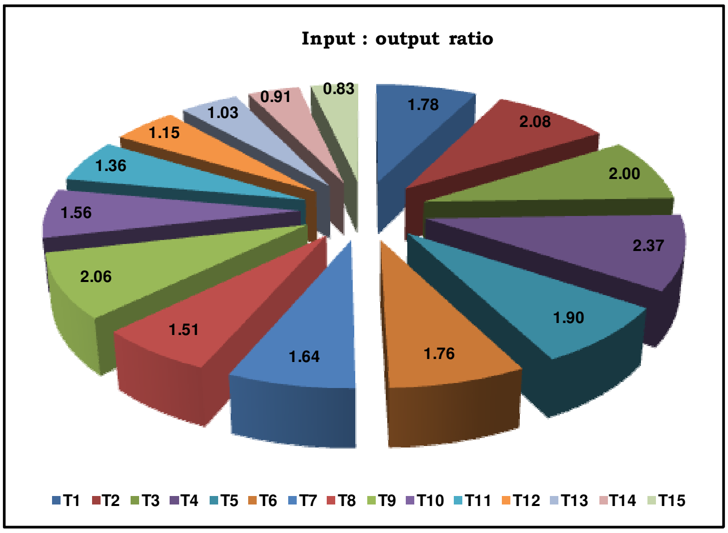

Figure 1. Effect of maleic hydrazide and TIBA on input : output ratio

Conclusion

Results indicated that application of TIBA @ 20 mg l-1 significantly increased dry matter plant-1 and yield contributing characters viz., yield plant-1 and yield hectare-1. Increase in yield plant-1 and yield hectare-1 following 20 mg l-1 TIBA was 22.60 and 22.80% respectively over the control of mung.

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