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INFLUENCE OF MH AND TIBA ON BIOCHEMICAL TRAITS, YIELD AND YIELD CONTRIBUTING PARAMETERS OF MUSTARD

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ABSTRACT

Present investigation was undertaken at farm of Botany section, College of Agriculture, Nagpur during *rabi* 2015-16 to study the effect of one foliar spray of MH (25 ppm, 50 ppm, 75 ppm, 100 ppm, 125 ppm, 150 ppm) and TIBA (25 ppm, 50 ppm, 75 ppm, 100 ppm, 125 ppm, 150 ppm) on the biochemical traits and yield of mustard cv. ACN-9 (Shatabdi). Data revealed that foliar application of 50 ppm TIBA followed by 100 ppm MH significantly enhanced leaf chlorophyll content, leaf nitrogen, leaf phosphorus, leaf potassium, seed oil, number of siliqua plant^{-1}, number of seeds 20^{-1} siliqua, 1000 seed weight, seed yield ha^{-1}, per cent increase in yield ha^{-1} and B:C ratio over control.

(Key words: Mustard, MH, TIBA, biochemical traits and yield)

INTRODUCTION

Mustard (*Brassica juncea*) is a second important oil seed crop in India after groundnut in area and production. It belongs to family Cruciferae with chromosome number 2n = 36. Major states producing mustard in India are Rajasthan, Gujarat etc. At present, mustard is mostly grown as oil seed crop in Maharashtra.

Oil content of Indian mustard seed varies from 30 to 48%. It is known, that Indian mustard seed is largely crushed for oil which is rich source of energy, predominantly in vegetarian diet. Apart from culinary purpose, oil is also used for medicinal purpose, preparation of hair oil and making soap. Mustard seed is considered as excellent source of dietary protein. Mustard is an important oil seed crop next to groundnut.

Mustard yield can be increased either by breeding lines which retain a large proportion of flower producing siliqua or through physiological manipulations such as spray of growth regulators which reduce flower drop. Many workers have observed the changes in physiological and morphological aspects of plants due to application of growth regulators and on this aspect a considerable amount of literature has been accumulated. MH (Maleic hydrazide), TIBA (2, 3, 5-triiodobenzoic acid), a-indolebutyric acid, a-napthalene acetic acid, 2, 4, 5-trichlorophenoxy acetic acid, cycocel, mepiquat chloride, synamic acid, B-nine (N-dimethyl amino succinamic acid), gallic acid etc. are the common growth retardants.

The plant growth regulators are compounds that as chemical signals, controlling the plant development. They normally bind to receptors in the plant, triggering a series of cellular changes, which may affect the initiation or modification of tissues and organs (Taiz and Zeiger, 2009).

MATERIALS AND METHODS

A field experiment on mustard was conducted at an experimental farm of Botany section, College of agriculture, Nagpur. The present investigation was undertaken during the *rabi* season of 2015-16. The field experiment was laid out in Randomized block Design (RBD) with three replications consisting of thirteen treatments with different concentrations of MH (25 ppm, 50 ppm, 75 ppm, 100 ppm, 125 ppm, 150 ppm) and TIBA (25 ppm, 50 ppm, 75 ppm, 100 ppm, 125 ppm, 150 ppm). One foliar spray of MH and TIBA was done at 35 DAS with hand sprayer. Plot size of individual treatment was gross 3.15 m X 3.30 m and net 2.25 m X 3.00 m. Observations on leaf chlorophyll content, leaf nitrogen, leaf phosphorus and leaf potassium content were recorded at 35, 50, 65 and 80 DAS. Nitrogen content in leaves was estimated as per methods suggested by Somichi *et al.* (1972), phosphorus and potassium content from leaves were estimated as per method suggested by Jackson (1967). Chlorophyll from leaves was estimated by colorimetric method as suggested by Bruinsma (1982). Estimation of oil content of mustard cultivars was done by Soxhlet's procedure (Shankaran). Seed oil content, number of siliqua plant^{-1}, number of seeds 20^{-1} siliqua, 1000 seed weight, seed yield ha^{-1}, per cent increase in yield ha^{-1} and B:C ratio was also 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).

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RESULTS AND DISCUSSION

Biochemical parameters

Observations on leaf chlorophyll content, leaf nitrogen, leaf phosphorus and leaf potassium content were recorded at 35, 50, 65 and 80 DAS. Seed oil content was also recorded after harvesting.

Leaf chlorophyll content

It is obvious from the data that chlorophyll content in leaves was maximum at 50 and 65 DAS but thereafter, gradually decreased at 80 DAS. Nitrogen is a constituent element in chlorophyll which rapidly increases at vegetative stage as the nitrogen reserves are in ample quantity at this stage.

Data recorded at 35 DAS was found non significant because foliar spray of MH and TIBA was done at 35 DAS.

At 50 DAS significantly more leaf chlorophyll content was noticed with the foliar application of 50 ppm TIBA (T_9) followed by foliar application of 100 ppm MH (T_5), 75 ppm TIBA (T_{10}) and 125 ppm MH (T_6) when compared with control (T_1) and rest of the treatments under study. Next to these treatments foliar application of 100 ppm TIBA (T_{11}), 25 ppm TIBA (T_8), 150 ppm MH (T_7), 75 ppm MH (T_4), 125 ppm TIBA (T_{12}), 50 ppm MH (T_3), 25 ppm MH (T_2) and 50 ppm MH (T_{13}) in a descending manner also significantly increased leaf chlorophyll content when compared with control (T_1) and rest of the treatments.

At 65 DAS significantly maximum leaf chlorophyll content was noticed with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm TIBA (T_{10}) and 125 ppm MH (T_6) when compared with control (T_1) and rest of the treatments under study. Similarly foliar application of 150 ppm MH (T_7), 75 ppm MH (T_4), 25 ppm TIBA (T_8), 100 ppm TIBA (T_{11}) and 50 ppm MH (T_3) were also increased leaf chlorophyll content significantly when compared with control (T_1) and rest of the treatments under observation. While, treatments T_{12} (125 ppm TIBA), T_2 (25 ppm MH) and T_{13} (50 ppm MH) were found at par with treatment T_1 (control).

At 80 DAS significantly increase in leaf chlorophyll content was noticed with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm TIBA (T_{10}) and 125 ppm MH (T_6) when compared with control (T_1) and rest of the treatments under study. Similarly foliar application of 100 ppm TIBA (T_{11}), 75 ppm MH (T_4), 150 ppm MH (T_7), 125 ppm TIBA (T_{12}), 50 ppm MH (T_3), 150 ppm TIBA (T_{13}) and 25 ppm TIBA (T_8) were also increased leaf chlorophyll content when compared with control (T_1) and rest of the treatments under observation. While, treatments T_2 (25 ppm MH) was found at par with treatment T_1 (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 grana 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 leaf 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.

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

Nitrogen is the important constituent of protein and protoplasm and essential for plant growth. Nitrogen deficiency causes chlorosis and malfunctioning of the photosynthesis process. Plant cells require adequate supply of N for normal cell division and growth of the plant. Tender shoots, tips of shoots buds, leaves contains higher nitrogen content (Jain, 2010).

Data recorded significant variations at all the stages of observations viz., 50, 65 and 80 DAS except 35 DAS.

At 50 DAS significantly maximum leaf nitrogen content was recorded with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm TIBA (T_{10}), 125 ppm MH (T_6) and 75 ppm MH (T_4) when compared with control (T_1). Treatments of 50 ppm MH (T_3), 100 ppm TIBA (T_{11}), 25 ppm MH (T_2), 25 ppm TIBA (T_8), 150 ppm MH (T_7), 125 ppm TIBA (T_{12}) and 150 ppm TIBA (T_{13}) were found at par with treatment T_1 (control).

At 65 DAS significantly maximum leaf nitrogen content was recorded with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm TIBA (T_{10}), 125 ppm MH (T_6), 75 ppm MH (T_4) and 50 ppm MH (T_3) over control (T_1). While, treatments T_8 (25 ppm TIBA), T_{11} (100 ppm TIBA), T_7 (150 ppm MH), T_2 (25 ppm MH), T_{12} (125 ppm TIBA) and T_{13} (150 ppm TIBA) were found at par with treatment T_1 (control).

At 80 DAS significantly maximum leaf nitrogen content was recorded with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm TIBA (T_{10}), 125 ppm MH (T_6), 75 ppm MH (T_4), 100 ppm TIBA (T_{11}) and 25 ppm TIBA (T_8) over control (T_1). Next to these treatments foliar spray of 125 ppm TIBA (T_{12}) was recorded significantly maximum leaf nitrogen content over control (T_1). While, treatments T_7 (150 ppm MH), T_3 (50 ppm MH), T_2 (50 ppm MH) and T_{13} (150 ppm TIBA) were found at par with treatment T_1 (control).

The inferences drawn from the data, it is clear that leaf nitrogen content was gradually decreased at 50 DAS, 65 DAS and at 80 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.

Deotale *et al.* (1994) conducted field experiment on physiological studies in safflower (*Carthamus tinctorius* L.) cv. Bhima. Plants were sprayed with 100-1100 ppm TIBA at 40 days after sowing. TIBA application @ 600 ppm significantly increased leaf nitrogen contents over control and rest of the treatments.

Leaf phosphorus content

Phosphorus is an important constituent of protoplasm, phospholipids, coenzymes NAD, ATP and nucleic acid and nucleio protein also, through nucleic acids and ATP, it plays an important role in protein synthesis. It is essential for the formation of seed.

Data observed significant variations at all the stages of observations viz., 50, 65 and 80 DAS except 35 DAS.

At 50 and 65 DAS significantly maximum leaf phosphorus content was recorded with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm TIBA (T_{10}), 125 ppm MH (T_6), 100 ppm TIBA (T_{11}) and 75 ppm MH (T_4) when compared with control (T_1). Treatments of 25 ppm TIBA (T_8), 150 ppm MH (T_7), 125 ppm TIBA (T_{12}), 50 ppm MH (T_3), 150 ppm TIBA (T_{13}) and 25 ppm MH (T_2) were found at par with treatment T_1 (control).

At 80 DAS significantly maximum leaf phosphorus content was recorded with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm TIBA (T_{10}), 125 ppm MH (T_6), 100 ppm TIBA (T_{11}) and 75 ppm MH (T_4) when compared with control (T_1). Next to these treatments foliar spray of 25 ppm TIBA (T_8) and 150 ppm MH (T_7) were found superior over control (T_1). Treatments of 125 ppm TIBA (T_{12}), 50 ppm MH (T_3), 150 ppm TIBA (T_{13}) and 25 ppm MH (T_2) were found at par with treatment T_1 (control).

It is evident from the data that phosphorus content in leaves was decreased gradually up to 50, 65 and 80 DAS. It might be because of translocation of leaf phosphorus and it'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).

Bobade (2015) observed that foliar sprays of MH 100 ppm followed by TIBA 50 ppm on green gram cv. PKV mung 8802 at 25 and 35 DAS significantly enhanced leaf phosphorus content when compared with control and rest of the treatments.

Leaf potassium content

Potassium is an essential macronutrient for the process of respiration, photosynthesis and many physiological processes in plant. It plays important role in stomatal movements and acts as an activator of many enzymes involved in protein synthesis. It is important for crop yield as well as for the quality of edible parts of crops. Although K is not assimilated into organic matter, K deficiency has a strong impact on plant metabolism. Plant responses to low K involve changes in the concentrations of many metabolites as well as alteration in the transcriptional levels of many genes.

Data were subjected to statistical analysis and were found significant at 50, 65 and 80 DAS, except 35 DAS.

At 50 DAS significantly maximum leaf potassium content was noticed with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm TIBA (T_{10}), 125 ppm MH (T_6), 75 ppm MH (T_4) and 100 ppm TIBA (T_{11}) significantly increased leaf potassium content when compared with control (T_1) and rest of the treatments under observation. Treatments T_8 (25 ppm TIBA), T_7 (150 ppm MH), T_{12} (125 ppm TIBA), T_3 (50 ppm MH), T_{13} (150 ppm TIBA), and T_2 (25 ppm MH) were found at par with treatment T_1 (control) in leaf potassium content.

At 65 and 80 DAS significantly maximum leaf potassium content was recorded with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm TIBA (T_{10}), 125 ppm MH (T_6) and 75 ppm MH (T_4) when compared with control (T_1) and rest of the treatments under observation. But treatments T_{11} (100 ppm TIBA), T_8 (25 ppm TIBA), T_7 (150 ppm MH), T_{12} (125 ppm TIBA), T_3 (50 ppm MH), T_{13} (150 ppm TIBA) and T_2 (25 ppm MH) were found at par with treatment T_1 (control) in leaf potassium content.

Sawant (2014) observed that foliar application of TIBA @ 50 ppm at 25 and 40 DAS on chickpea cv. Jaki-9218 significantly enhanced leaf potassium content over control and rest of the treatments.

Oil content in seed

Oil content was found significantly maximum in treatment 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5) and 75 ppm TIBA (T_{10}) when compared with control (T_1). Next to these treatments, treatments T_6 (125 ppm MH), T_8 (25 ppm TIBA) and T_{11} (100 ppm TIBA) were found significant in oil content when compared with T_1 (control). Treatments T_{12} (125 pm TIBA), T_7 (150 ppm MH), T_{13} (150 ppm TIBA), T_4 (75 ppm MH), T_3 (50 ppm MH) and T_2 (25 ppm MH) were found at par with treatment T_1 (control) in oil content.

Table 1. Effect of maleic hydrazide and TIBA on chemical and biochemical traits in mustard

Treatments	Leaf chlorophyll content (mg g^{-1})				Leaf nitrogen content (%)				Leaf phosphorus content (%)				Leaf potassium content (%)				Seed oil content (%)
	35 DAS	50 DAS	65 DAS	80 DAS	35 DAS	50 DAS	65 DAS	80 DAS	35 DAS	50 DAS	65 DAS	80 DAS	35 DAS	50 DAS	65 DAS	80 DAS	
T_1 (Control)	1.47	1.32	1.18	0.53	6.96	4.63	3.36	2.08	0.363	0.286	0.232	0.142	3.32	2.43	2.37	2.03	29.50
T_2 (25 ppm MH)	1.53	1.43	1.21	0.57	6.67	4.86	3.53	2.37	0.346	0.291	0.238	0.157	3.41	2.58	2.52	2.07	32.06
T_3 (50 ppm MH)	1.63	1.47	1.24	0.59	6.38	5.07	3.86	2.51	0.289	0.296	0.242	0.159	3.51	2.69	2.61	2.11	33.07
T_4 (75 ppm MH)	1.64	1.52	1.30	0.62	7.21	5.28	3.95	2.84	0.367	0.327	0.273	0.193	3.72	3.17	2.96	2.27	33.57
T_5 (100 ppm MH)	1.66	1.60	1.38	0.68	6.47	5.43	4.17	3.09	0.351	0.349	0.295	0.213	3.82	3.28	3.14	2.41	39.74
T_6 (125 ppm MH)	1.60	1.58	1.35	0.65	6.81	5.38	4.04	2.93	0.371	0.338	0.284	0.197	3.76	3.21	3.05	2.32	36.27
T_7 (150 ppm MH)	1.59	1.53	1.32	0.61	7.08	4.79	3.62	2.54	0.387	0.318	0.264	0.181	3.52	2.82	2.71	2.16	34.12
T_8 (25 ppm TIBA)	1.64	1.54	1.29	0.57	7.10	4.83	3.73	2.68	0.361	0.321	0.267	0.186	3.58	2.93	2.83	2.21	35.82
T_9 (50 ppm TIBA)	1.67	1.62	1.40	0.69	6.62	5.67	4.23	3.14	0.401	0.357	0.303	0.219	3.87	3.32	3.16	2.46	41.65
T_{10} (75 ppm TIBA)	1.68	1.59	1.37	0.67	6.53	5.41	4.14	2.97	0.382	0.343	0.289	0.209	3.79	3.25	3.09	2.37	37.46
T_{11} (100 ppm TIBA)	1.64	1.55	1.28	0.63	6.57	4.89	3.67	2.75	0.411	0.336	0.282	0.195	3.66	3.09	2.84	2.25	35.28
T_{12} (125 ppm TIBA)	1.62	1.50	1.23	0.60	6.34	4.65	3.49	2.63	0.381	0.298	0.244	0.164	3.47	2.79	2.63	2.18	34.73
T_{13} (150 ppm TIBA)	1.59	1.43	1.19	0.58	6.75	4.51	3.41	2.34	0.364	0.293	0.239	0.158	3.43	2.65	2.57	2.13	33.79
SE(m)±	0.043	0.021	0.019	0.015	0.412	0.208	0.153	0.158	0.022	0.014	0.013	0.011	0.228	0.180	0.171	0.080	1.792
CD at 5%	-	0.062	0.054	0.044	-	0.608	0.447	0.462	-	0.040	0.038	0.032	-	0.524	0.500	0.232	5.231

Table 2. Effect of maleic hydrazide and TIBA on yield and yield contributing parameters in mustard

Treatments	Number of siliqua plant^{-1}	Number of seeds 20^{-1} siliqua	1000 seed weight (g)	Seed yield ha^{-1} (q)	Per cent increase in yield ha^{-1}	B:C Ratio
T_1 (Control)	128.37	228.87	3.01	6.31	-	1.81
T_2 (25 ppm MH)	130.90	235.93	3.40	6.52	3.16	1.87
T_3 (50 ppm MH)	133.77	240.83	3.53	6.71	6.33	1.93
T_4 (75 ppm MH)	136.53	244.70	3.55	7.02	10.45	2.01
T_5 (100 ppm MH)	142.90	257.17	3.67	7.58	20.12	2.18
T_6 (125 ppm MH)	139.73	255.50	3.64	7.25	14.89	2.09
T_7 (150 ppm MH)	132.60	239.70	3.57	6.74	6.81	1.94
T_8 (25 ppm TIBA)	137.17	242.87	3.51	7.30	15.68	2.06
T_9 (50 ppm TIBA)	143.60	260.70	3.73	7.82	23.93	2.16
T_{10} (75 ppm TIBA)	140.10	246.93	3.66	7.40	17.27	2.01
T_{11} (100 ppm TIBA)	131.20	244.77	3.61	7.27	15.21	1.94
T_{12} (125 ppm TIBA)	130.50	243.97	3.59	6.87	8.87	1.80
T_{13} (150 ppm TIBA)	128.80	235.80	3.50	6.53	3.48	1.68
SE(m)±	1.340	5.057	0.107	0.269	-	–
CD at 5%	3.911	14.762	0.313	0.785	-	_

Yield and yield contributing parameters

Number of siliqua plant^{-1}

Significantly increases in number of siliqua plant^{-1} were observed with the foliar application of 50 ppm TIBA (T_9) followed by foliar application of 100 ppm MH (T_5), 75 ppm TIBA (T_{10}), and 125 ppm MH (T_6) when compared with control (T_1) and rest of the treatments under observation. Similarly foliar application of 25 ppm TIBA (T_8), 75 ppm MH (T_4), 50 ppm MH (T_3) and 150 ppm MH (T_7), in a descending manner also increased number of pods plant^{-1} over the control (T_1). But, the treatments T_{11} (100 ppm TIBA), T_2 (25 ppm MH), T_{12} (125 ppm TIBA) and T_{13} (150 ppm TIBA) were found at par with T_1 (control).

Kumar *et al.* (2006) reported that foliar application of TIBA (50 ppm), cycocel (250 ppm) and mepiquat chloride (1000 ppm) on soybean recorded highest number of pods plant^{-1} and shelling percentage as compared to control.

Number of seeds 20^{-1} siliqua

Significantly more number of seeds 20^{-1} siliqua were recorded with the foliar application of 50 ppm TIBA (T_9) followed with 100 ppm MH (T_5), 125 ppm MH (T_6) and 75 ppm TIBA (T_{10}) when compared with control (T_1) and rest of the treatments under observation. Similarly foliar application of 100 ppm TIBA (T_{11}), 75 ppm MH (T_4) and 125 ppm TIBA (T_{12}) significantly increased more number of seeds 20^{-1} siliqua when compared with control (T_1) and rest of the treatments under observation. Treatments T_8 (25 ppm TIBA), T_3 (50 ppm MH), T_7 (150 ppm MH), T_2 (25 ppm MH) and T_{13} (150 ppm TIBA) were found at par with T_1 (control).

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 number of seeds plant^{-1} over the control of mung.

1000 seed weight (g)

Significantly maximum 1000 seed weight was recorded by treatment T_9 (50 ppm TIBA) followed by T_5 (100 ppm MH), T_{10} (75 ppm TIBA), T_6 (125 ppm MH), T_{11} (100 ppm TIBA), T_{12} (125 ppm TIBA), T_7 (150 ppm MH), T_4 (75 ppm MH), T_3 (50 ppm MH), T_8 (25 ppm TIBA) and T_{13} (150 ppm TIBA) in descending manner when compared with treatment T_1 (control) and rest of the treatments under study. Treatment T_2 (25 ppm MH) also gave significantly more 1000 seed weight when compared with treatment T_1 (control).

Jahan and Khan (2014) tested 20, 50, 100 and 150 ppm TIBA on growth and yield of BARI soybean -5. They observed that application of 100 and 150 ppm TIBA significantly increased 100 seed weight.

Seed yield ha^{-1}(q)

Significantly maximum seed yield ha^{-1} were recorded with the foliar application of 50 ppm TIBA (T_9) followed by 100 ppm MH (T_5), 75 ppm MH (T_{10}), 25 ppm TIBA (T_8) and 125 ppm MH (T_6) over control (T_1). Next to these treatments, treatment T_4 (75 ppm MH) was also recorded maximum seed yield ha^{-1} when compared with the treatment T_1 (control). Treatments T_{11} (100 ppm TIBA), T_7 (150 ppm MH), T_3 (50 ppm MH), T_{12} (125 ppm TIBA), T_2 (25 ppm MH) and T_{13} (150 ppm TIBA) were found at par with (T_1) control.

Field studies conducted by Shinde (2010) revealed that the application of TIBA (100 ppm) recorded significantly maximum seed yield in soybean.

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.

Per cent increase in yield ha^{-1} and B:C ratio

The highest per cent increase in yield over control was observed in treatment sprayed with 50 ppm TIBA i.e. 23.93 % followed by 100 ppm MH i.e. 20.12 %. The highest B:C ratio was observed by the foliar application of 100 ppm MH (1:2.18) followed by 50 ppm TIBA (1:2.16) and 125 ppm MH (1:2.09).

Sawant (2014) studied the effect of foliar sprays of growth retardant TIBA with different 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 per cent increase in yield ha^{-1} and B:C ratio over control and rest of the treatments.

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