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Research Article

CHANGES IN GROWTH AND METABOLIC ACTIVITY OF MOONG PLANTS (*PHASEOLUS RADIATUS*) INDUCED BY BIOPESTICIDE NEEM AND ITS COMBINED DOSES WITH IRON AND ZINC

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ABSTRACT

The present investigation was conducted to study the effect of biopesticide neem and its interactive effects with iron and zinc on growth and metabolic activity of moong plants (*Phaseolus radiatus*). Six doses were supplied in the concentration of 0.5% neem, 1% neem, 2% neem, 5% neem, 2% neem + 5.6ppm Fe and 2% neem+15ppm Zn. Root length, shoot length and percentage germination of moong plants were found to be increased under the effect of neem treatments. Both the micronutrients further enhanced root and shoot growth when supplied with 2% neem. Upto 18% and 35% increase in root growth and upto 73% and 92% increase in shoot growth was observed at combined dose of 2% neem+5.6ppm Fe and 2% neem+15ppm Zn respectively whereas increase of only upto 12% and 63% was observed at 2% neem dose with respect to that in control in these parameters. 5% neem treatment was however found to be toxic to some extent as it decreased the plant growth. Chlorophyll content and protein content of moong plants were also increased with increasing doses of neem except at 5% dose of neem. An increase of 22.93% was observed in chlorophyll content at 2% neem+5.6ppm Fe whereas upto 95% increase in protein content was observed at 2% neem+15ppm Zn dose. Catalase activity increased whereas peroxidase activity decreased with increasing doses of neem except at 5% dose. Both 5.6ppm Fe and 15ppm Zn, when supplied separately with 2% neem showed additional increasing effect in catalse activity.

INTRODUCTION

Pesticides are known polluters of environment and their improper usage in traditional as well as modern exploitative agriculture has created havoc. Scientists throughout the world have been addressing the problems of long term ill effect of chemical pesticides used in the cultivation of crops (Jayaraj, 2000). Widespread use of pesticides over the years has resulted in problems caused by their interaction with biological systems in the environment. The enormous and continued use of pesticides has added to the environment pollution to such an extent that human health is adversely affected and ecosystems are endangered (Kanekar *et al*., 2004). Moreover as per general practices in the field, farmers even do not wait till the prescribed pre or post harvest time frame and supply their produce to the market at the earliest for monetary requirements (Sinha *et al*., 2016).

Due to their negative impact on health & environment pesticides previously used in agriculture are being banned and their use is being seriously curtailed. Discovery & use of alternate safe botanical pesticides has thus become an essential requisite (Hegde, 1996). Neem and its byproducts as an alternate of harmful pesticides are gaining importance throughout the world. The Neem tree (*Azadirachta indica* A. Juss). is known for thousands of years in the Indian sub continent by different names such as Indian liliac, Margosa tree (Gupta and Singh, 2002). It redresses several agriculture issues and safeguards the environment. Neem is a versatile tree of tropics with immense potential to protect the environment while developing sustainable agriculture. Neem based pesticides are safe, non-toxic & do not keep any residual effects on agricultural produce. Use of neem products for plant protection can help in reducing the atmospheric pollution & preventing the food poisoning. It can also reduce the demand for chemical pesticide, which will subsequently reduce industrial production of agrochemicals (Hegde, 1996).

The present experiment was hence done to study the effect of biopesticide neem and its interactive effects with two micronutrients Iron (Fe) and Zinc (Zn) on growth and metabolic activity of an important pulse crop moong (*Phaseolus radiatus*).

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MATERIALS AND METHODS

Petridish experiments were carried out to study the effect of different doses of Neem and its interactive effects with Iron and Zinc on growth & metabolism of Moong plants.

Seeds were soaked in controlled nutrient solution and the respective test solution in petriplates with the filter papers liberally moistened with the solution in which the seeds were soaked. Total 22 seeds were soaked. The nutrient solution were again changed after 12 hours & then after 24 hours. No. of seeds germinated were counted for calculation of germination %. Six doses were supplied in the concentration of 0.5%, 1%, 2%, 5% neem and 2% neem + 5.6ppm Fe and 2% neem + 15ppm Zn. Controlled solution was also supplied.

5 ml of basal nutrient solution was supplied to control and 3 ml each of different concentration of neem + 2 ml of nutrient solution was supplied in respective petriplate. In case of combined dose of 2% neem with either 5.6ppm Fe or 15ppm Zn, neem and Fe/Zn was supplied in the ratio 3:2.

1. Growth of selected plants: Growth parameters observed included root length, shoot length & seed germination.
2. Metabolic parameters: Metabolic parameters such as concentration of chlorophyll, protein and activities of enzymes like catalase and peroxidase were analysed.

Root and shoot length of 3 plants in each petriplate was measured. Observations were taken on alternate days. Total five readings were taken. Average root & shoot length was calculated replicate wise and then treatment wise. Percentage increase/decrease in growth in comparison to control was calculated after final readings.

Chlorophyll was measured by the method of Petering *et al*. (1940). Protein estimation was done by the method of Lowery *et al*. (1951). Catalase and peroxidase activity were assayed by the method of Euler & Josephsen (1927) and Luck (1963) respectively.

RESULTS AND DISCUSSION

Root length of moong plants increased under the effect of neem treatments. However growth in root length was not significant at 0.5% dose. Also at the highest dose of 5% decrease in growth was observed (Table-1).

Table 1 Effect of neem on root length, shoot length and germination% of moong plants

Treatment	Root Length (cm)	Growth achieved	Shoot Length (cm)	Growth achieved	Germination %
Control	4.13 ± 0.11	5.43 (0.00)	2.28 ± 0.06	3.27 (0.00)	95.45
0.50%	4.34 ± 0.12	5.62 (3.50)	2.70 ± 0.15	3.80 (16.21)	93.18
1%	4.49 ± 0.14	5.87 (8.10)	3.20 ± 0.14	4.60 (40.67)	95.45
2%	4.72 ± 0.11	6.11 (12.52)	3.93 ± 0.11	5.34 (63.30)	97.73
2% + Fe	4.98 ± 0.08	6.45 (18.78)	4.16 ± 0.08	5.67 (73.39)	93.18
2% + Zn	5.48 ± 0.15	7.37 (35.73)	4.70 ± 0.14	6.29 (92.35)	95.45
5%	3.71 ± 0.21	4.94 (-9.02)	2.48 ± 0.11	3.49 (6.73)	88.64
CD Value at 5%	0.1721		0.1399		1.6859

Values are given as average value of 5 dates ± SM. Values in bracket under growth achieved column reflects % increase or % decrease in growth achieved with respect to Control

Both the micronutrients 5.6 ppm Fe and 15ppm Zn showed positive effect on root growth when supplied with 2% neem and an increase of 35.73% was observed in root growth at combined dose of 2% neem + 15ppm Zn with respect to that in control. Tiyagi and Alam, (1993) also observed neem to be beneficial on germination & root nodulation of chick pea and mungbean crop.

Neem treatments proved to be highly beneficial on shoot length of moong plants. Even the highest test dose of 5% showed an increase of 6.73% in shoot growth with respect to that in control (Table-1). Both the micronutrients further enhanced the shoot growth when supplied with 2% neem however supplementation of Zn proved to be more beneficial than Fe. 63.30% increase in shoot length was observed at 2% neem dose whereas 73.39% and 92.35% increase in shoot length was observed at 2% neem + 5.6ppm Fe and 2% neem+ 15ppm Zn respectively compared to that achieved in control. Soil amendments with neem oil control biotic stress and ensure better plant growth and yields (Yadav *et al*., 1997). Neem seed kernel extract (NSKE) on cowpea grains gave significantly higher yield than untreated control plants (Gupta and Singh, 2002).

Neem treatments showed mixed effects on germination percentage of moong plants. Both the micronutrients when supplied separately with 2% neem treatments failed to provide any significant enhancement on this parameter. Germination percentage increased due to 1% neem and 2% neem treatment. At 2% neem + 15ppm Zn dose it was at par to that in control (Table-1). However germination percentage decreased at 0.5% neem, 2% neem + 5.6ppm Fe, & 5% neem treatments. Seed soaking in aqueous extract of cake, kernel & seed coat of neem proved efficacious against *M. incognita* without affecting the germination of chickpea (Mojumder & Misra, 1993).

All doses of neem, except 5%, enhanced the chlorophyll content of moong plants (Table-2). 5.6ppm Fe proved to be more effective than 15ppm Zn in enhancing the chlorophyll content when supplied with 2% basal dose. An increase of 22.93% was observed in chlorophyll content at 2% neem + 5.6ppm Fe with respect to that in control whereas increase 17.61% and 11.22% was observed in plants treated with 2% neem + 15ppm Zn and 2% neem alone dose respectively. Tiyagi and Alam, (1993) observed increase in chlorophyll content and plant height in chick pea due to neem seed cake treatment. Pushnik *et al*., (1984) found that Fe chlorotic leaves were very poor in chlorophyll bearing proteins.

Protein content also increased with increasing doses of neem except at 5% dose at which protein content decreased (Table-2). Both the micronutrients proved to be highly beneficial on this parameter when supplemented with basal dose of 2% neem. Upto 79% and 95% increase in protein content of moong plants was observed at 2% neem + 5.6ppm Fe and 2% neem+ 15ppm Zn dose respectively whereas this increase was upto 47% at 2% neem dose. Soil amendment or seed dressing with neem cake remarkably increased the plant growth & grain yield (Gupta *et al*., 1993). Catalase activity increased with increasing doses of neem. Both 5.6ppm Fe and 15ppm Zn, when supplied separately with 2% neem showed additional increasing effect (Table-2). However, increase in catalase activity due to the combined dose of 2% neem + 5.6ppm Fe was more significant

than that due to 2% neem + 15ppm Zn. Also 5% neem treatments decreased the catalase activity.

Table 2 Effect of neem on chlorophyll content, protein content, catalase activity and peroxidase activity of moong plants

Treatment	Chlorophyll Content	Protein Content	Catalase Activity	Peroxidase Activity
	(mg./gm.f.wt.)	(mg./gm.f.wt.)	(μ mole H2O2 split / 100 mg f.wt.)	(Δ O.D./100 mg f.wt.)
Control	1.8901 ± 0.0046 (0.00)	115.6539 ± 0.7922 (0.00)	37.50 ± 2.50 (0.00)	0.0535 ± 0.0015 (0.00)
0.50%	1.9381 ± 0.0124 (2.54)	123.5754 ± 2.3765 (6.85)	42.50 ± 2.50 (13.33)	0.0480 ± 0.0020 (-10.28)
1%	1.9985 ± 0.0170 (5.73)	141.0027 ± 1.5843 (21.92)	45.00 ± 0.00 (20.00)	0.0410 ± 0.0020 (-23.36)
2%	2.1022 ± 0.0124 (11.22)	170.7083 ± 1.9804 (47.60)	47.50 ± 2.50 (26.67)	0.0280 ± 0.0020 (-47.66)
2% + Fe	2.3235 ± 0.0077 (22.93)	207.1472 ± 2.7725 (79.11)	57.50 ± 2.50 (53.33)	0.0335 ± 0.0015 (-37.38)
2% + Zn	2.2229 ± 0.0093 (17.61)	226.1588 ± 1.9804 (95.55)	52.50 ± 2.50 (40.00)	0.0215 ± 0.0015 (-59.81)
5%	1.7926 ± 0.0124 (-5.16)	96.6423 ± 2.3765 (-16.44)	27.50 ± 2.50 (-26.67)	0.0705 ± 0.0035 (31.78)
CD Value at 5%	0.0165	2.6709	3.9020	0.0029

Values are given as ± SM. Values in bracket reflects % increase or % decrease with respect to Control

Higher CAT activity might have helped in reducing toxic H_2O_2 species exhibiting the ameliorative effect of neem on stress induced by dimethoate and cypermethrin doses in tomato (Sinha and Tandon, 2016).

Peroxidase activity was found to be decreased with increasing doses of biopesticide neem except at 5% dose at which peroxidase was highest and was 31.78% more than that in control (Table-2). A combined dose of 2% neem + 5.6ppm Fe also increased the peroxidase activity as compared to that at 2% neem dose though still it was less than that in control. 15ppmZn when supplied with 2% neem showed additional decreasing effect.

CONCLUSION

Neem enhanced growth and metabolic activity upto 2%, however, 5% neem treatment was found to be toxic to some extent as it decreased the plant growth. Higher dose of neem was found to have some toxic effects on growth and metabolic activity of moong plants. Supplementation of micronutrients 5.6 ppm Fe and 15ppm Zn proved to be further stimulatory on plant growth and metabolic activity when supplied with 2% basal dose of neem as percent increase of more than 90% was observed in some parameters due to supplementation of 15ppm Zn. A positive correlation was seen between shoot length and protein content of plants. 5.6 ppm Fe was found to be beneficial in increasing the chlorophyll content whereas 15ppm Zn was found to have better effect on overall plant growth and protein content of moong plants. Catalase and peroxidase were found to work in some kind of synchronization as increase in catalase activity was associated with decrease in perosidase activity at most of the doses.

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