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IMPACT OF CHEMICALS (PESTICIDE & FUNGICIDE) AND ORGANIC MANURE ON ROOT NODULATION, GROWTH OF ROOT AND SHOOT OF CHICKPEA (*CICER ARIETINUM*) PLANT

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Abstract

Modern agricultural practices like use of chemical fertilizer and pesticides are responsible for many health issues in people and contaminate to water, air and soils. Therefore, the present investigation was designed to assess the impact of pesticides and organic manure on growth of plant and number of root nodules of chick pea. The chickpea (*Cicer arietinum)* is an annual legume of family Fabaceae. Pot experiment were conducted with four treatments of each pesticide (*i.e.*, Control, 25ppm, 50ppm and 100ppm) and vice versa organic manure mixture of chicken manure and cow dung (*i.e.*, Control, 5g, 10g and 20g) in three replicate of each in complete randomized design (CRD). Seeds were surface sterilized with 0.1% aqueous $HgCl_2$ solution and sown in earthen pots containing 3.5 kg of double sterilized soil. Pots were kept in glass house and precaution was taken to prevent contamination of soil with *Rhizobium* until inoculation. Before spraying of pesticides, the pots were inoculated with equal amount of homogeneous suspension of an appropriate strain of *Rhizobium*. Results indicated that concentration fungicide (Bavistin) of 25ppm increased the number of nodules significantly while 50 and 100ppm concentrations significantly inhibited number of nodules. Use of insecticides (Carbofuran) reduced number of nodules on increasing concentration but significant reduction was observed at 50 and 100ppm. Shoot and root length were decreases on increasing the concentration of fungicides and insecticides. While use of organic manure increases number of nodules, shoot and root length of plant but significant increased was observed at 10 and 20g manure.

***Key words*:** Pesticides, rhizosphere, root nodulation, chickpea and *Rhizobium*.

Introduction

The term rhizosphere was introduced by Hiltner (1904) to denote the region of the soil which feels the influence of plant root system. The well- studied rhizosphere effect describes the phenomenon that, in comparison with bulk of soil, the biomass and activity of microorganism is enhanced as a result of exudation of compounds by the root (Raajmakers *et al*., 2009). Rhizosphere is a specialized ecological niche where soil is subjected to specific influence by plant root tissues. Rhizosphere represents a poorly defined zone of soil with a microbial gradient in which maximum changes in the population of soil micycoflora occur in soil adjacent to root and decline from distance away from it. Clark (1949) proposed the ecological niche provided for micro-organisms by root surface be designated as the 'rhizoplane.'

Foliar application of chemicals and their influence on the rhizosphere mycoflora being showed reduction in the bacterial population in the rhizosphere soil. Pudeko and Madrazak (2004) studied the effect of carbendazim and fungicide Funaben-t on the nodulation of soybean and reported depression in nodulation when both treatment were used simultaneously. Kumar and Gupta reported the adverse effect of Thiophanate methyl and Dithane M-45 on nodulation in *Vigna sinensis*. Chandra *et al*. (2001) reported the adverse effect of insecticides on nodulation and growth of plant. Sriramachandra-sekharan and Vaiyapuri (2003) reported the adverse effect of carbafuran on nodulation in black gram at higher concentration. Effect of fungicides and insecticides as seed treatment and foliar Application has been studied by several workers. Sugavanam *et al*. (1994) reported that root nodulation, growth and yield of the host plant were not significantly affected by the application of fungicides, except the interference of 2-methoxyethyl mercury chloride in the early growth. Basu (1998) reported that foliar application of Dithane M-45 and Bavistin promoted the growth and nodulation in ground nut (*Arachis hypogea).* Dogra *et al*. (1998) observed that carbendazim treatment did not show any significant effect on stem length and internodes of *Phaseolus vulgaris* and *P. aureus* but decreased nodule number at 100 ppm treated plants over the control. Naidu and Harinath (2000) reported that seeds treated with captan and carbosulfan decreased nodulation and pod yield over the control. Beaulah and Jerlin (2001) studied the effect of atrazine on nodulation and growth of *Vigna mungo* and they reported that higher concentrations of atrazine reduced

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nodulation and growth of plant. Bilandzic *et al*. (2006) reported that Carbendazim and Flutriafol treatment reduced the number of nodules but produced healthiest plants. Dev (2006) reported that higher concentration of carbendazim reduced the nodule number in *Glycine max.* Singh (2009) reported that fungicide Bavistin reduced the number of nodules in *Cyamopsis tetragonoloba* (L.).

Annapurna *et al*. (2000) studied the effect of different insecticides in association with *Bradyrhizobium japonicum* on plant growth, nodulation and yield of soybean cv. Pusa-16. They reported that application of insecticides significantly increased crop yields. However, no significant differences between treatments were observed on nodule number and nodule dry weight. Singh *et al*. (2002) studied the effect of six insecticides and recorded lesser number and dry weight of nodules per plant compared to untreated and uninoculated control. Babu (2005) reported that insecticides depressed the number of nodules but the depression was not statistically significant. Dev (2006) observed that higher concentration of insecticide (Carbofuran) reduced the number of effective nodules. Singh (2009) also reported adverse effect of insecticide or nodulation.

Effect of organic fertilizer on nodulation and plant growth has been studied by a few workers *viz*., Browaldh (1992); Selvam *et al*. (2000) and Nagrajan and Balachandar (2002) and Chorey *et al*. (2001) studied the effect of farmyard manure in combination with fertilizer on yield of soybean, nodulation, plant height, number of branches and number of root nodules per plant and observed that all parameters were significantly influenced by application. Devi and Devi (2002) reported that cow dung, rabit dung, goat dung, pig dung and poultry manure when applied at 400 kg/ha to soil on which arhar and mung bean were grown, increased plant growth and nodule number. Nagrajan and Balachandar (2002) reportd that farmyard manure and cowdung manure enhanced biomass, root nodulation and grain yield of black gram and green gram. Gayen *et al*. (2004) reported that decomposed cowdung and urine mixture without inorganic fertilizer promoted the number of nodules. Dev (2006) reported that chicken and cow dung manure considerably increased the number of effective nodules and growth in *Glycine max* (L) Merrill.

Cowdung compost and chicken manure significantly increased growth and nodulation of bean plants (Browaldh, 1992). Devi (2002) also reported that cowdung, rabbit, goat, pig and poultry manure when applied at the rate of 100 kg/ha in soil on which arhar and moong bean were grown increased plant growth and nodulation. Farm yard manure and cowdung manure application enhanced biomass root nodulation and grain yield (Nagrajan and Balachandran, 2002; Dev and Gupta, 2006; Gopinath *et al*., 2008). Therefore, present investigation was designed to study the impact chemicals and different source of manure on the nodulation and growth of chickpea. Main emphasis had been given to find out lethal doses and impact of different chemicals on nodulation process and plant growth.

Materials and Methods

The chickpea (*Cicer arietinum*) is an annual legume of the family Fabaceae, subfamily Faboideae Baynes and Smith, 1880). Its different types are variously known as gram (Bell, 2014). Chickpea seeds are high in protein. It is one of the earliest cultivated legumes and 7500-year-old remains have been found in the Middle East. The chickpea is important in Indian, Mediterranean and Middle Eastern cuisine. In 2017, India produced 67% of the world total for chickpeas.

Experimentation: The present investigation was designed to assess the impact of pesticides and organic manure on growth of plant shoot and root length and number of root nodules of chickpea. Pot experiment were conducted with four treatments of each pesticide (Bavistin and Crbofuran) *i.e.*, Control, 25ppm, 50ppm and 100ppm and vice versa organic manure mixture of chicken manure and cow dung were grinded properly and mixed in three doses *viz*., 5g, 10g and 20g/pot separately in three replicate of each in complete randomized design (CRD). Untreated pots (pots without manure and fertilizer) served as control. Seeds were surface sterilized with 0.1% aqueous $HgCl_2$ solution and sown in earthen pots containing 3.5 kg of double sterilized soil. Pots were kept in glass house and precaution was taken to prevent contamination of soil with *Rhizobium* until inoculation. After 10 days of showing, 10 seedling of equal size were selected and retained in each pot and rest were removed. The pots were inoculated before spraying of pesticides with equal amounts of a homogenous suspension of an appropriate strain of *Rhizobium*, which was isolated from pink nodules of test plant. Nodule number, shoot and root length was recorded and data were statistically analysed.

Results and Discussion

Effect of Foliar Spray of Fungicide (Bavistin)

Nodule Number, Shoot and Root Length: In the present investigation, it was found that, concentration of 25ppm increased the number of nodules significantly while 50 and l00ppm concentration significantly inhibited the number of nodules. All the three concenmtions reduced shoot length but significant effect was noted only concentration 100ppm. All these concentrations of bavistin had no significant adverse effect on root length (Table 1, Plate 1 and Fig 1). Effect of foliar application of fungicides has been studied by a few workers. Dogra *et al*. (1998) reported that lower concentration of Dithane M-45 significantly increased the number of nodules whereas higher concentration proved toxic on nodulation and growth of plant. Beaulal and Jerlin (2001) reported that higher concentration of atrazin reduced nodulation and plant growth. Peudeko and Madrzak (2004) studied the effect Funaben-T and observed poor nodulation in

soybean. Bilandzic *et al*. (2006) and Dev (2006) reported that Carbendazin and Flurietal treatment produced of the number of nodulation but produced healthiest plant.

The present finding are in accordance with the observation of Beaulal and Jerlin (2001), Bilandzic *et al*. (2006), Dev (2006) and Singh (2009) who reported that increasing concentration of fungicide decreased the number and size of effective nodules.

Effect of Foliar Spray of Insecticide (Carbofuran)

In the present investigation, it has been found that 25, 50 and 100ppm concentration of Carbofuran reduced the number of nodules but significant reduction in the number of nodules was found at 50 and 100ppm concentrations. Maximum inhibition was noted at 100ppm concentration. However, only 100ppm concentration significantly inhibited shoot and root length (Table 2, Plate 2 and Fig 2).

Srinivasa *et al*. (1998) reported that the application of phorate to soil promoted the number of effective nodules and nodule dry weight per plant. Soloman and Emosairur (1999) studied the effect of insecticide, (Lamdacythalothrin) and reported that the lnsecticide was applied as a foliar spray + soil drench gave the highest number of nodules followed by control, but not all nodules were viable and differences in nodulation were not statistically significant. Annapurna *et al*. (2000) reported adverse effect of insecticide on nodule number and on nodule dry weight. Sriramachand-rasekharan and Vaiyapuri (2003) reported that the higher concentration of carbofuran decreases the number of nodules. Babu (2005) and Singh (2009) reported adverse effect of higher concentration of insecticide on nodulation in the leguminous plant.

The present findings, so far as high concentrations are concerned, accordance with the observations of Chandra *et al*. (2001), Sriramchnadrasekharan and Vaiyapuri (2003), Babu (2005) and Singh (2009) reported that the increased concentration of insecticide caused a decrease in both nodule number and nodule volume.

Effect of Organic Manures (Chicken Manure and Cow dung Manure) Amendment to Soil

Nodule number, shoot and root length: In present investigation, it was found that all the treatments *viz*., 5g, 10g, 20g of both the organic manures promoted the number of nodules, shoot and root length but significant promotion in the number of nodules and length of shoot and root was found only in 10g and 20g treatments. Whereas, in case of root only 20g, treatment significantly increased the length of root. Chicken manure was more effective than cow dung manure (Table 3 & 4, Plate 3 & 4 and Fig 3 & 4).

Soil amendment effect of organic manures on nodulation and growth of leguminous plants has been studied by a few workers. Selvam *et al*. (2000) studied the effect of organic manures and inorganic fertilizer on nodulation in Soybean and reported that number of root nodules recorded at 60 days after sowing was significantly influenced by the combined application of organic manures and inorganic fertilizers.

Chorey *et al*. (2001) reported that the effect of organic manures in combination with fertilizers significantly influenced the number of root nodules, plant height and root length. Nagarjan and Balachandar (2002) And Desh Mukh (2005) reported that the organic manure amendment enhanced the plant growth and nodulation in leguminous plants. Devi (2002) reported that when organic manure amendments applied at 400 kg/ha to soil on arhar (*Cajanus cajan*) and moong bean (*Vigna sinensis*) were grown increased plant growth and nodulation. Devi and Hassan (2002) reported that farmyard manure and poultry manures were applied to soil at 10 and 20 t/ha few day before sowing encouraged nodulation and plant growth. Gayen *et al*. (2004) reported that the composed cow dung and urine mixture promoted the number of nodules. Gina *et al*. (2006) reported that application of composted and fresh solid swine manure showed positive residual effect on soybean growth and yield. Dev and Gupta (2006) reported that chicken manure was more effective than cowdung manure in promoting the number of nodules. Singh (2009) reported that the application of organic manures encouraged nodulation and plant growth. The present findings are in accordance with the observations of Chorey (2001), Gayen *et al.* (2004). Dev and Gupta (2006) and Singh (2009).

Thus, effect of foliar spray of fungicide (Bavistin) on nodule number, shoot and root length was studied. Foliar spray at 25ppm concentration significantly increased the number of nodules whereas 50 and 100ppm spray significantly inhibited the number of nodule. 100ppm concentration spray has significant adverse effect on shoot length were as al these concentration have no significant adverse effect on root length. Effect of foliar spray of insecticide (Carbofuran) on nodule number, shoot and root length was studied. Carbofuran spray inhibited the number of nodules at all the three concentrations but significant adverse effect was noticed at 50 and 100ppm concentrations. 25 and 50ppm concentrations did not have any adverse effect on shoot and root length. Maximum inhibition in the number of nodule, shoot alld root length was observed at 100ppm concentration.

Effect of chicken manure and cow dung manure amendment to soil on nodule number, shoot and root length was studied in pot condition. Both the organic manures significantly increased the number of nodules, Shoot and root length. Nodule number, shoot and root length was found to increase with increase in doses. Maximum increase was noted at 20g/pot. Chicken manure was more effective than cow dung manure.

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Table 1: Effect of foliar spray of different concentration of fungicide (Bavistin) on nodule number, shoot and root length

Treatment	Concentration	Mean no. of nodule	Value	Mean shoot length(cm)	Value of 't'	Mean root length(cm)	Value of 't'
Bavistin	Control	29.0	--	25.20	--	25.60	--
	25 ppm	30.2	2.14**	25.67	0.52	24.64	0.56
	50 ppm	24.5	3.43**	25.30	0.86	24.25	1.02
	100 ppm	20.5	9.60**	22.59	3.12**	24.15	1.26

Significant at 1% level=2.87
Significant at 5% level=2.10

Table 2: Effect of foliar spray of different concentration of insecticide (Carbofuran) on nodule number, shoot and root length

Treatment	Concentration	Mean no. of nodule	Value of 't'	Mean shoot length(cm)	Value of 't'	Mean root length(cm)	Value of 't'
Carbofuran	Control	29.0	--	25.20	--	25.60	--
	25 ppm	27.2	1.14	25.68	0.31	24.52	1.34
	50 ppm	25.5	3.35**	24.8	0.65	24.20	1.98
	100 ppm	22.4	6.51**	22.85	2.65*	23.40	2.50*

Significant at 1% level=2.87
Significant at 5% level=2.10

Table 3: Effect of organic manures (Chicken Manure and Cow dung Manure) amendment to soil on nodule number, shoot and root length

Treatment	Concentration	Mean no. of nodule	Value of 't'	Mean shoot length(cm)	Value of 't'	Mean root length(cm)	Value of 't'
Organic manure	Control	29.4	-	20.86	--	24.41	--
	5.0 g	30.8	0.84	22.52	2.04	25.74	1.14
	10 .0 g	32.6	2.61*	23.68	2.73	25.89	1.44
	20.0 g	36.8	5.49**	25.82	6.74**	27.02	2.58*

Significant at 1% level=2.87
Significant at 5% level=2.10

Table 4: Effect of organic manures (Cow dung Manure) amendment to soil on nodule number, shoot and root length

Treatment	Concentration	Mean no. of nodule	Value	Mean shoot length(cm)	Value of 't'	Mean root length(cm)	Value of 't'
Organic manure	Control	29.4	-	20.86	--	24.41	--
	5.0 g	30.2	0.72	22.16	1.68	24.98	0.67
	10 .0 g	32.0	2.47*	23.85	2.97*	25.289	0.86
	20.0 g	35.0	5.91**	25.16	6.68**	26.42	2.30*

Significant at 1% level=2.87
Significant at 5% level=2.10

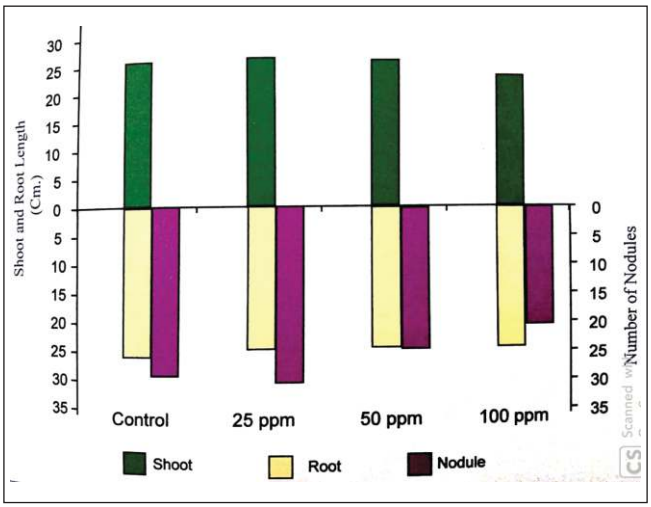

Fig. 1: Effect of foliar spray of different concentration of fungicide (Bavistin) on nodule number, shoot and root length

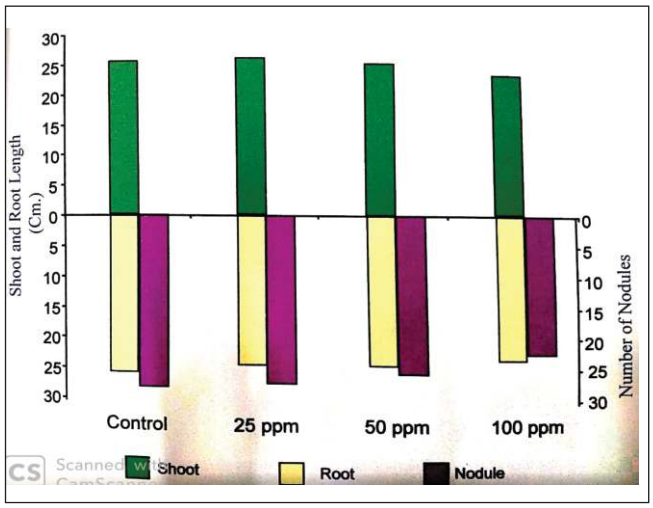

Fig. 2: Effect of foliar spray of different concentration of insecticide (Carbofuran) on nodule number, shoot and root length

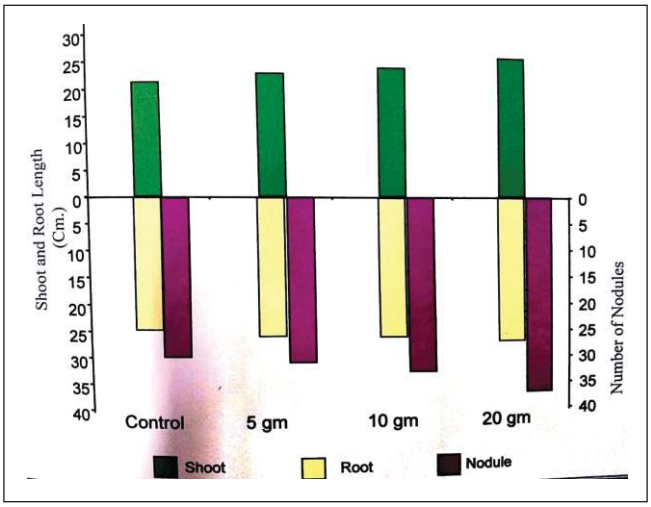

Fig. 3: Effect of manures (Chicken Manure and Cow dung Manure) amendment to soil on nodule number, shoot and root length

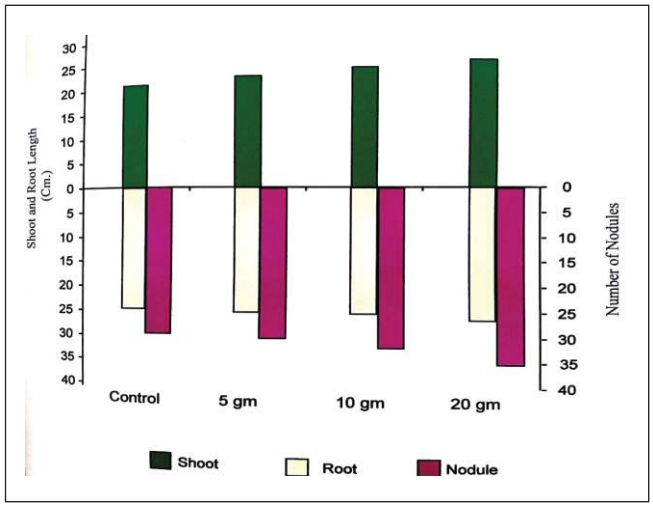

Fig. 4: Effect of organic manures (Cow dung Manure) amendment to soil on nodule number, shoot and root length

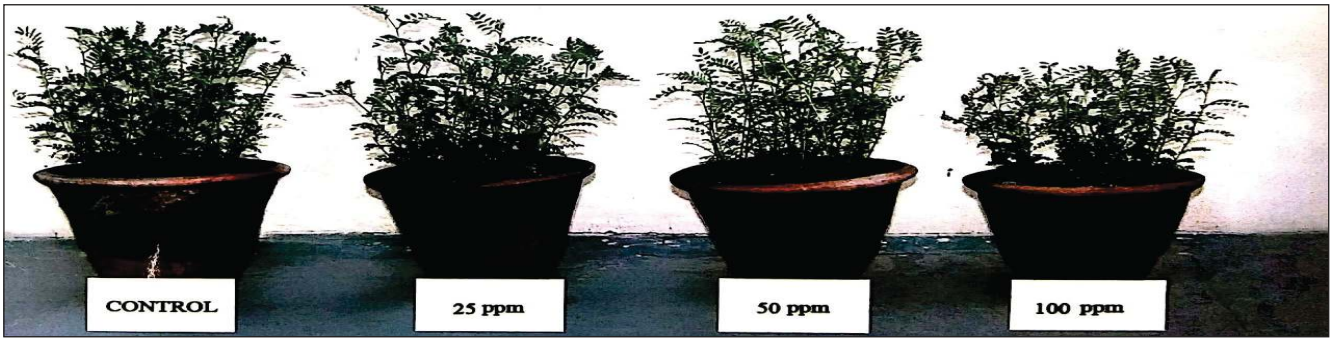

Plate 1: Effect of foliar spray of fungicide (Bavistin) on Plant height

Plate 2: Effect of foliar spray of insecticide (Carbofuran) on plant height

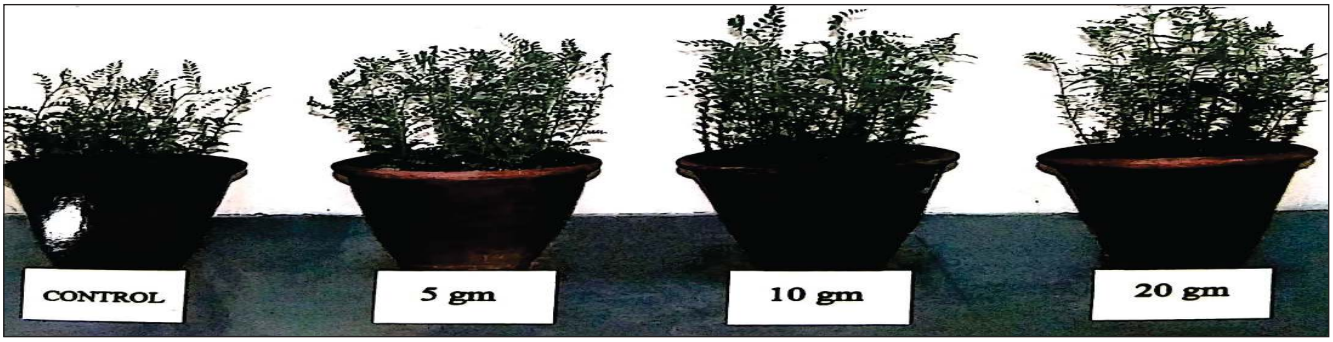

Plate 3: Effect of organic manures (Chicken Manure and Cow dung Manure) amendment to soil plant height

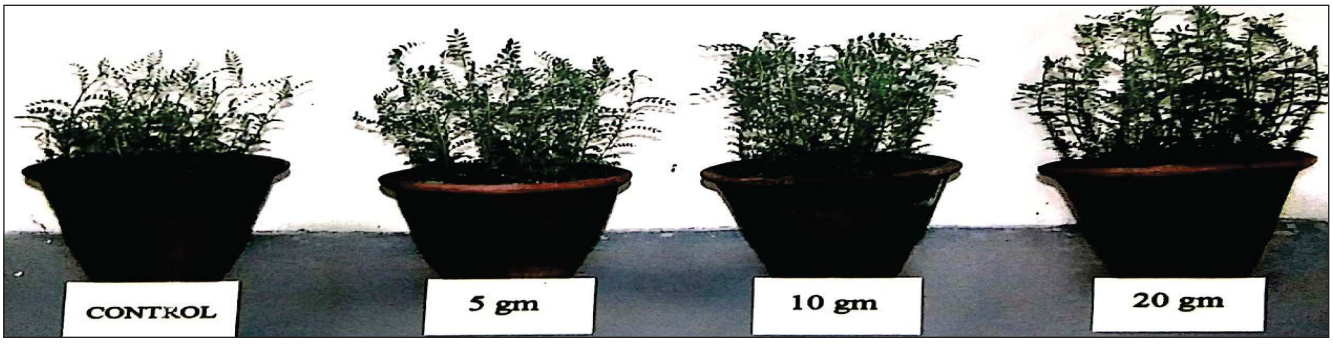

Plate 4: Effect of organic manures (Cow dung Manure) amendment to soil plant height