

TO STUDY THE EFFECTS OF NAA AND MH ON NUMBER OF FRUITS AND YIELD IN CHILLI (*Capsicum annum L.*)

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ABSTRACT:

The fruit set and fresh as well as dry weight in chilli were affected by growth regulators. Foliar spray of NAA significantly increased the number of fruits per plant at all the three stages of single spray as well as triple spray and at all the concentrations used. In 50 ppm NAA treatment of triple spray, number of fruit per plant was 186.9 as compared to 133.5 in control. In MH treated plants, the number of fruits per plant was increased significantly in all the three single sprays and triple spray upto 25 ppm while it was gradually decreased at 50 and 100 concentrations of MH. Foliar application of NAA significantly increased fresh green fruit yield per plant in all the treatments. Maximum fresh green fruit yield of about 500.00 gm per plant was recorded at 50 ppm NAA treatment of triple spray. In general, MH is considered to be a growth inhibitor but it showed promoting effect on fresh green fruit yield in chilli. There was an increase in the yield at lower doses upto 25 ppm and then it was reduced at higher doses in all the stages of single spray as well as triple spray treatment. The foliar application of NAA also increased significantly the yield of fresh as well as dry red fruit per plant at all the concentrations used. The maximum yield of fresh red fruit (583.13gm) and dry red fruit (154.65gm) was recorded at NAA 50 ppm of triple spray treatment which is more than double to the yield of control. Foliar application of MH increased the yield of fresh red fruit as well as dry red fruit yield upto 10 ppm concentrations and then it was drastically decreased at higher doses of MH in all the treatments.

KEYWORDS: *NAA(Naphthalene acetic acid),MH(Maleic hydrazide),DAT (days after transplantation).*

INTRODUCTION:-

The present studies were undertaken to study the effects of naphthalene acetic acid (NAA) and maleic hydrazide(MH) on number of fruits and fruit yield in *Capsicum annum L.*

The bioregulators, NAA and MH modify the growth, development, fruit set and fruit yield. The effects of foliar application of NAA has been found to modify the yield characters in various plants. Different concentrations of NAA produced noticeable changes in number of fruits and yield in different crops. The

impact of NAA on these characters have been studied in various crops viz. brinjal (Patel et al., 1997; Meena and Dhaka, 2003), potato (Tomar and Ramgiry, 1997), okra (Munda et al., 2000 and Surendra et al., 2006), chilli (Raja et al., 2016; Bharti et al., 2017) and tomato, cucumber and gourds (Pandey and Rai, 2006). Desai et al. (1994) have observed that the foliar application of NAA influenced the yield in watermelon. Prabhu and Natrajan (2006) studied that foliar spray of NAA increased fruit length, girth and weight in ivy gourd. Prasad et al. (2013) studied that foliar spray of NAA increased yield in tomato.

Foliar spray of MH at different concentrations influenced the fruit yield. The effect of MH on yield characters have been studied in various crops viz potato (Kaul and Mehta, 1994; Caldiz et al., 1997 and Caldiz et al., 2001), fenugreek (Alagukannan and Vijayakumar, 1998), tomato (El- Habbasha et al., 1999), egg plant (Rahman and Natrajan, 1999 a), china aster (Geetha et al., 2000) and soyabean (Rahman et al., 2004).

Kumar et al. (2000) have found that the application of 1000-3000 ppm of MH solution retained the healthy bulb during storage in onion. Kooner et al. (2000) have observed that foliar spray at 5 ppm to 10 ppm of MH increased total yield in bottle gourd. Rahman et al. (2004) have reported that foliar application of MH increased pod per plant, seed per fruit and seed yield in soyabean. Mahajan et al. (2006) have recorded that weed control showed significant improvement in yield of red chilli.

MATERIALS AND METHODS:-

The experiments were carried out to study the effects of NAA and MH on fruit set and fresh as well as dry fruit weight (yield) in chilli (*Capsicum annum L.*). The plants were sprayed with aqueous solution each of NAA and MH at 5, 10, 25, 50 and 100 ppm concentrations. The plants were sprayed singly at three stages viz. S₁ (40 DAT), S₂ (55 DAT) & S₃ (70 DAT) and thrice at all these stages. Yield of fresh green fruit was studied at the age 140 days after transplantation (DAT) and following observations were made at the age of 160 days after transplantation (at the time of harvesting).

1. Number of fruits per plant
2. Yield of fresh green fruits per plant
3. Yield of fresh red fruits per plant
4. Yield of dry red fruit

Total number of fruits of 5 plants per treatment was counted and then mean was calculated. The fruits of five plants per treatment were collected to study the fresh weight of ripened red fruits and then fruit were oven dried to get yield of dry red fruits. The data were analysed statistically and the experimental significance was tested with t test and F test (CD).

OBSERVATIONS:-**Number of Fruits:-**

The experimental findings on fruit set and fruit yield are presented in tables 1-2 & photo plate 1-6. Perusal of data from table 1 and photo plate (1-3) shows that the foliar spray of NAA treatments, the number of fruits per plant was significantly increased at all the stages of spray and at all the concentrations used. Number of fruits per plant was gradually increased with the increasing concentrations of NAA upto 50 ppm and then decreased at 100 ppm treatment but the number of fruits was still higher as compared to control. Single foliar spray at the age of 70 DAT (S_3) showed more number of fruits at various concentrations used as compared to single foliar spray at the age 40 DAT (S_1) and 55 DAT (S_2). In triple spray treatments, the number of fruits was gradually increased up to 50 ppm and the increase was found to be highly significant. In 50 ppm NAA treatment of triple spray, number of fruits per plant was 186.9 as compared to 133.5 in control. It means, there was an increase of 53.4 fruits per plants. Triple foliar application of NAA was found more effective as compared to any of the single foliar application. It is evident from table 2 and photo plate 4-5 that the number of fruits per plant was increased significantly in all the three single sprays upto 25 ppm concentration while it was gradually decreased at 50 & 100 ppm concentrations of MH. The number of fruits at 50 ppm treatment was found still higher than control in all the three stages of single spray but in 100 ppm treatment, the number of fruits was lesser than that of control. Among all the stages of the treatments, S_2 (55 DAT) is found to be most effective in comparison to S_1 & S_3 . The maximum number of fruits (161.20) was recorded in S_2 stage of single spray at 25 ppm. Triple foliar spray of MH was found to be most effective among all treatments and it increased the number of fruits upto 50 ppm than drastic fall in number of fruits was recorded at 50 & 100 ppm. The maximum number of fruits (156.80) was recorded at 25 ppm concentration of MH as compared to 133.50 fruits in control. The increase in number of fruits upto 50 ppm is probably due to increase in number of branches & flowers while decrease in number of fruits may be due to pollen sterility, flower and fruit drop at higher dose.

Table - 1

Effect of NAA on number of fruits per plant in chilli

(Capsicum annum L)

Treatments	Number of fruits							
	Single Spray						Triple Spray	
	S ₁		S ₂		S ₃		S ₁ +S ₂ +S ₃	
	Mean ± SE	CV%	Mean ± SE	CV%	Mean ± SE	CV%	Mean ± SE	CV%
Control	133.5 ± 0.807	2.701	133.5 ± 0.807	2.701	133.5 ± 0.807	2.701	133.5 ± 0.807	2.701
NAA 5 ppm	138.8 ± 0.147**	3.693	148.4 ± 1.196**	3.603	155.8 ± 0.674**	1.934	161.9 ± 1.544**	4.263
10 ppm	143.9 ± 0.890**	2.767	160.7 ± 0.905**	2.518	167.4 ± 0.660**	1.762	178.3 ± 0.728**	1.825
25 ppm	144.2 ± 0.851**	2.639	161.5 ± 0.901**	2.495	171.8 ± 0.755**	1.963	182.7 ± 0.987**	2.415
50 ppm	146.7 ± 0.606**	1.846	163.0 ± 0.798**	2.190	173.9 ± 1.207**	3.102	186.9 ± 1.024**	2.249
100 ppm	138.7 ± 0.894**	2.882	141.9 ± 0.602**	1.898	151.6 ± 0.840**	2.477	154.7 ± 0.866**	2.502

*Significant at P = 0.05

**Significant at P = 0.01

Table - 2

Effect of MH on number of fruits per plant in chilli

(Capsicum annum L.)

Treatments	Number of fruits							
	Single Spray						Triple Spray	
	S ₁		S ₂		S ₃		S ₁ +S ₂ +S ₃	
	Mean ± SE	CV%	Mean ± SE	CV%	Mean ± SE	CV%	Mean ± SE	CV%

Control	133.50 ± 0.807 2.701	133.50 ± 0.807 2.701	133.50 ± 0.807 2.701	133.50 ± 0.807 2.701
MH 5 ppm	135.70 ± 0.707** 2.328	148.80*± 1.523** 4.576	141.20 ± 0.784** 2.482	151.20 ± 0.628** 1.857
10 ppm	136.80 ± 0.640** 2.091	155.30 ± 1.0883** 2.542	144.30 ± 0.745** 2.307	153.00 ± 0.859** 2.509
25 ppm	139.40 ± 0.933** 2.992	161.20 ± 0.724** 2.008	150.20 ± 1.118** 3.327	156.80 ± 1.251** 3.566
50 ppm	136.40 ± 0.897** 2.942	157.70 ± 1.195** 3.380	138.7 ± 0.744** 2.397	135.00 ± 0.797 2.639
100 ppm	130.20 ± 0.888** 3.051	137.00 ± 0.829** 2.706	117.40 ± 0.749** 2.851	115.10 ± 0.816** 3.169

*Significant at P = 0.05

**Significant at P = 0.01

EFFECT OF FOLIAR SPRAY OF NAA ON NUMBER OF FRUITS PER PLANT IN CHILLI

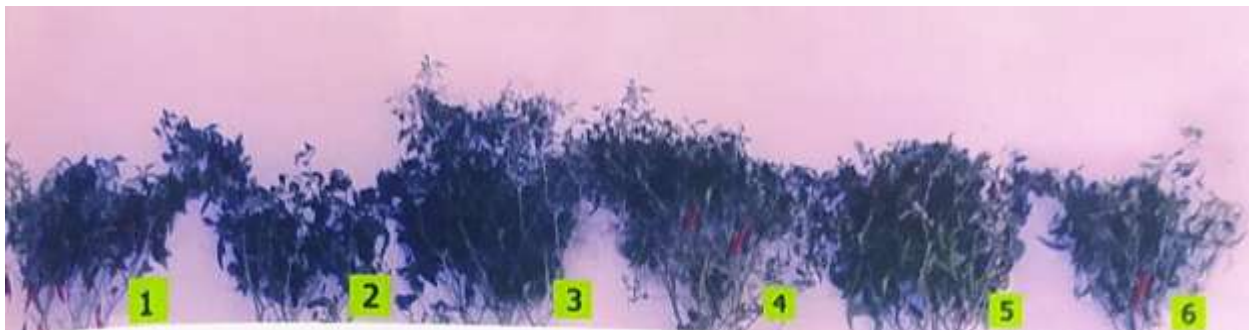


PHOTO PLATE 01: Single Foliar spray at S2 stage

1. Contol 2. 5ppm 3. 10ppm
4. 25ppm 5. 50ppm 6. 100ppm



PHOTO PLATE 02: Single Foliar spray at S3 stage

1. Contol 2. 5ppm 3. 10ppm
4. 25ppm 5. 50ppm 6. 100ppm



PHOTO PLATE 03: Single Foliar spray at S1+S2+S3 stage

1. Contol	2. 5ppm	3. 10ppm
4. 25ppm	5. 50ppm	6. 100ppm

EFFECT OF FOLLIAR SPRAY OF MH ON NUMBER OF FRUITS PER PLANT IN CHILLI



PHOTO PLATE 04: Single Foliar spray at S2 stage

1. Contol	2. 5ppm	3. 10ppm
4. 25ppm	5. 50ppm	6. 100ppm



PHOTO PLATE 05: Single Foliar spray at S3 stage

1. Contol	2. 5ppm	3. 10ppm
4. 25ppm	5. 50ppm	6. 100ppm



PHOTO PLATE 03: Single Foliar spray at S1+S2+S3 stage

1. Contol	2. 5ppm	3. 10ppm
4. 25ppm	5. 50ppm	6. 100ppm

Fresh green fruit yield:-

The experimental findings on the yield of fresh green fruit are presented in tables 3-4. Foliar application of NAA significantly increased the fresh green fruit yield per plant in all the three stages of single spray as well as triple spray at all the concentrations used. This increase in fresh green fruit per plant was directly proportional to the concentrations upto 50 ppm and then it was decreased at 100 ppm treatment. Among three stage of spray, S₃ stage (just before flowering) showed better results. Triple foliar spray showed more pronounced effect in increasing the fresh fruit yield as compared to single sprays as well as control. Maximum fresh green fruit yield of about 500 gm per plant was recorded at 50 ppm treatment of triple spray (table 3). In general, MH is considered to be a growth inhibitor but it showed promoting effect on fresh fruit yield in chilli. There was an increase in the yield of fresh green fruit at lower doses upto 25 ppm and then it was reduced at higher doses in all the stages of single spray as well as triple spray.

In case of MH treatments, S₂ stage of single spray and triple spray were found more effective (table 4). The variability induced for fresh fruit yield per plant did not show definite pattern but it was higher in case of MH treatments as compared to GA₃ and NAA treatments.

Table - 3

Effect of NAA on fresh green fruit yield (gm) per plant in chilli (*Capsicum annum L*)

Treatment	Single Spray						Triple Spray	
	S1		S2		S3		S1+S2+S3	
	Mean ± SE	CV%	Mean ± SE	CV%	Mean ± SE	CV%	Mean ± SE	CV%

Control	263.40 ± 0.81	1.39	263.40 ± 0.81	1.39	263.40 ± 0.81	1.39	263.40 ± 0.81	1.39
NAA 5 ppm	281.16 ± 0.81**	1.29	317.50 ± 0.70**	0.99	345.10 ± 0.68**	0.88	269.15 ± 0.86	1.04
10 ppm	304.00 ± 1.02**	1.49	365.60 ± 0.83**	1.01	376.80 ± 0.93**	1.10	439.70 ± 0.88**	0.99
25 ppm	327.24 ± 0.95**	1.30	384.25 ± 0.86**	1.50	425.50 ± 0.82**	0.86	455.20 ± 0.90**	0.80
50 ppm	346.50 ± 0.81**	1.05	398.20 ± 0.78**	1.10	446.25 ± 0.65**	0.65	499.95 ± 0.95**	0.95
100 ppm	284.70 ± 0.07**	1.68	296.10 ± 0.77**	0.87	325.60 ± 0.83**	1.15	340.34 ± 0.88**	1.16

* Significant at P = 0.05

S1 = Single spray at 40 days after transplantation (DAT)

** Significant at P = 0.01

S2 = Single spray at 45 days after transplantation (DAT)

S3 = Single spray at 70 days after transplantation (DAT)

Table – 4
Effect of MH on fresh green fruit yield (gm) per plant in chilli
(Capsicum annum L)

Treatment	Single Spray						Triple Spray	
	S1		S2		S3		S1+S2+S3	
	Mean ± SE	CV	Mean ± SE	CV	Mean ± SE	CV	Mean ± SE	CV
Control	263.40 ± 0.81	1.39	263.40 ± 0.81	1.39	263.40 ± 0.81	1.39	263.40 ± 0.81	1.39
MH 5 ppm	279.55 ± 0.99**	1.59	318.40 ± 1.02**	1.42	307.80 ± 0.91**	1.32	322.20 ± 1.14**	1.58
10 ppm	295.40 ± 1.26**	1.91	341.90 ± 0.91**	1.18	330.00 ± 1.09**	1.47	352.90 ± 0.91**	1.15
25 ppm	320.60 ± 1.09**	1.52	371.90 ± 0.97**	1.17	360.65 ± 0.97**	1.20	389.60 ± 1.28**	1.18
50 ppm	293.64 ± 1.17**	1.78	346.30 ± 0.96**	1.23	288.60 ± 0.99**	1.53	286.00 ± 1.01**	1.57
100 ppm	260.40 ± 0.22**	0.98	284.00 ± 0.99**	1.56	222.30 ± 1.03**	2.06	207.25 ± 1.01**	2.18

* Significant at P = 0.05

S1 = Single spray at 40 days after transplantation (DAT)

** Significant at P = 0.01

S2 = Single spray at 45 days after transplantation (DAT)

S3 = Single spray at 70 days after transplantation (DAT)

Fresh red fruit yield:-

The data of fresh red fruits yield per plant are presented in table 5-6. The foliar application of NAA also increased significantly the fruit yield. The data presented in table 5 shows that fresh red fruit yield was increased gradually and significantly at all the concentration used except 100 ppm and the increase was directly proportional to the concentration. Among all the single sprays, S₃ (70 DAT) was found most effective. The maximum yield at S₃ stage was recorded 521.70 gm per plant at 50 ppm as compared to 338.50 gm in control. The S₂ stage of single spray can be put on second rank as regard to fresh fruit yield. In case of NAA triple sprayed plants, the fresh red fruit yield was significantly increased in all the concentration used, however, the maximum yield 583.13 gm was recorded at 50 ppm concentration which is 244.63 gm. higher than that of control.

In case of MH treatments (table 6) there was a significant increase in fresh red fruit yield upto 10 ppm treatment in comparison to control and 10 ppm dose showed the maximum increase in fresh red fruit yield at all the three stages of single spray as well as triple spray. Higher concentrations of MH (25-100 ppm) of single spray as well as triple spray treatments gradually reduced the fresh red fruit yield and the decrease was inversely proportional to the concentrations. In case of single spray at S₃ stage and triple spray treatments, the fresh red fruit was lower than that of control at 50 and 100 ppm concentrations. Minimum fresh red fruit yield of 232.30 gm was recorded at 100 ppm of triple spray treatment.

Table -5

Effect of naphthalene acetic acid on fresh red fruit yield (gm) per plant in chilli

(Capsicum annum L)

Treatments	SINGLE SPRAY						TRIPLE SPRAY	
	S ₁		S ₂		S ₃		S ₁ +S ₂ +S ₃	
	Mean ± SE	CV%	Mean ± SE	CV%	Mean ± SE	CV%	Mean ± SE	CV%

Control	338.50 ± 0.80 1.06	338.50 ± 0.80 1.06	338.50 ± 0.80 1.06	338.50 ± 0.80 1.06
NAA 5 ppm	366.45 ± 1.07** 1.30	391.70 ± 0.731** 0.83	422.22 ± 0.87** 0.93	443.61 ± 1.03** 1.04
10 ppm	382.77 ± 0.66** 0.775	432.30 ± 1.10** 1.14	466.48 ± 0.95** 0.91	502.81 ± 1.13** 1.00
25 ppm	387.35 ± 1.44** 1.66	444.20 ± 1.46** 1.47	500.78 ± 1.04* 0.92	538.97 ± 1.24** 1.02
50 ppm	403.42 ± 0.88 ** 0.969	456.40 ± 0.88** 0.86	521.70 ± 1.17** 0.99	583.13 ± 0.86** 0.66
100 ppm	371.72 ± 0.93** 1.12	383.12 ± 4.01** 1.17	427.51± 0.93** 0.98	450.10 ± 0.75** 0.74

*Significant at P = 0.05

**Significant at P = 0.01

Table 6

Effect of maleic hydrazide (MH) on fresh fruit yield (gm) per plant in chilli

(Capsicum annum L)

Treatments	SINGLE SPRAY			TRIPLE SPRAY	
	S ₁	S ₂	S ₃	S ₁ +S ₂ +S ₃	
	Mean ± SE CV%	Mean ± SE CV%	Mean ± SE CV%	Mean ± SE CV%	CV%
Control	338.50 ± 0.80 1.06	338.5 ± 0.80 1.06	338.50 ± 0.80 1.06	338.5 ± 0.80	1.06
MH 5 ppm	358.25 ± 0.88** 1.10	403.25 ± 0.84** 0.93	398.18 ± 1.49** 1.68	444.53 ± 0.86**	0.87
10 ppm	378.94 ± 0.82** 0.97	496.96 ± 0.66** 0.60	477.63 ± 0.90** 0.85	547.74 ± 0.85**	0.69
25 ppm	376.38 ± 1.15** 1.37	473.90 ± 0.90** 0.84	450.60 ± 1.03** 1.01	449.00 ± 0.78**	0.78
50 ppm	365.55 ± 0.84** 1.03	457.30 ± 0.86** 0.84	347.35 ± 0.77** 1.00	320.60 ± 0.86**	1.20
100 ppm	351.54 ± 0.99** 1.26	372.65 ± 1.16** 1.39	292.10 ± 0.79** 1.21	232.30 ± 0.61**	1.12

*Significant at P = 0.05

**Significant at P = 0.01

Dry red fruit yield:-

The data for effect of NAA and MH on dry red fruit yield per plant in chilli are presented in table (7) and figs.(1-2). The statistical analysis of data showed a significant difference between the treatment and control as well as within the doses of hormones for dry fruit yield per plant.

In case of NAA treatment, there was a significant increase in dry fruit yield per plant in all the treatments as compared to control as well as with in the doses of NAA. The dry fruit yield per plant was gradually increased with the increasing concentrations of NAA upto 50 ppm in all the stages of spray except single spray at S₃ stage where it was increased upto 25 ppm concentration. At certain instances, the increase in dry fruit yield within the doses of NAA was not significant. Maximum yield of 154.65 gm was recorded at NAA 50 ppm of triple spray treatment, which is more than double to the yield of control (70.54gm).

Perusal of data from table 7 shows that in case of MH treatments also, the dry fruit yield per plant was increased upto 10 ppm concentration and then it was drastically decreased at higher doses of MH in all the treatments. There was a significant difference between the treatments and control as well as with in the doses of MH for dry fruit yield per plant. Single foliar spray of S₃ stage and triple foliar spray showed more drastic effect on dry fruit yield per plant and minimum dry fruit yield (58.56gm) was observed at 100 ppm treatment of triple spray.

Conclusion:

It may be concluded from the experimental observations of present investigation that growth regulators play an important vital role in regulation of fruit set and yield in chilli. It may be helpful to increase the yield and to improve the quality of chilli fruits. The practical utility of present investigation may be summarized that the foliar application of NAA increase the yield of chilli would help in solving the problem of spice and vegetable upto some extent for enormously increasing population. Foliar application of NAA and MH significantly increased the yield of fresh green as well as dry red fruits per plant at lower doses upto 25-50 ppm. The maximum yield of fresh red fruit (583.13 gm) and dry red fruit (154.65gm) was recorded at NAA 50 ppm of triple spray treatments which is more than double to the yield of control.

Table –7

Effect of NAA and MH on dry fruit yield (gm) per plant in chilli (Capsicum annum L.)

Treatment	Single Spray			Triple Spray
	S1	S2	S3	S ₁ +S ₂ +S ₃
	Mean	Mean	Mean	Mean
Control	70.54	70.54	70.54	70.54
NAA 5ppm	82.12	92.50	103.50	114.15
10ppm	86.38	106.75	119.55	135.25
25ppm	91.95	115.49	139.45	151.45
50ppm	99.65	117.97	137.80	154.65
100ppm	89.96	91.50	103.90	110.45
MH 5ppm	80.96	92.34	93.17	106.24
10ppm	86.00	117.28	113.68	134.20
25ppm	87.32	113.26	110.84	119.62
50ppm	85.54	112.04	104.00	86.30
100ppm	80.85	92.20	74.66	58.56

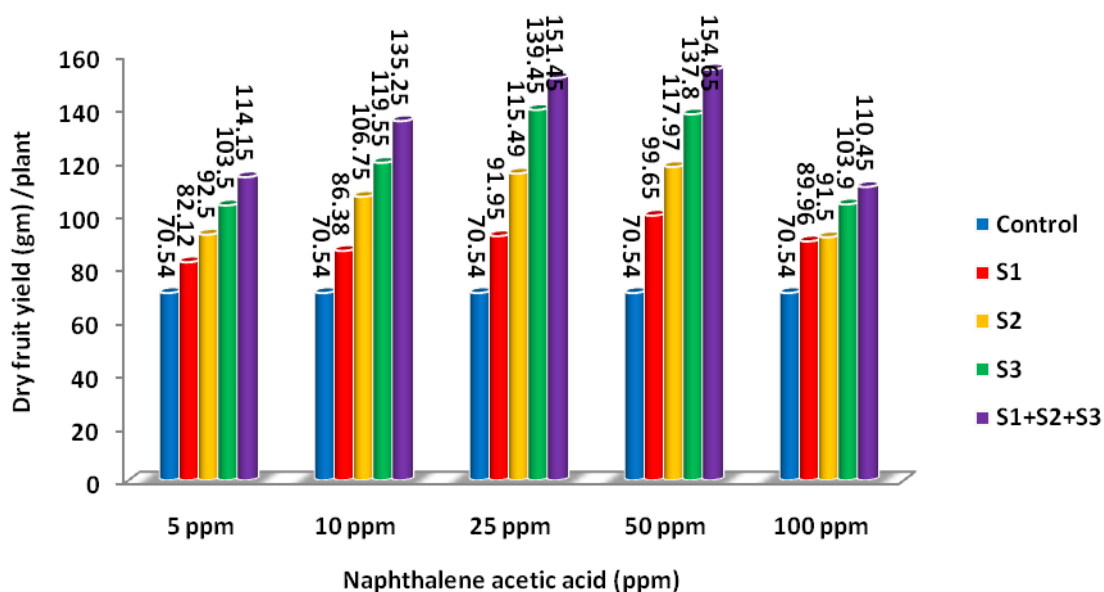


Fig – 1 : Effect of naphthalene acetic acid on dry fruit yield / plant in chilli

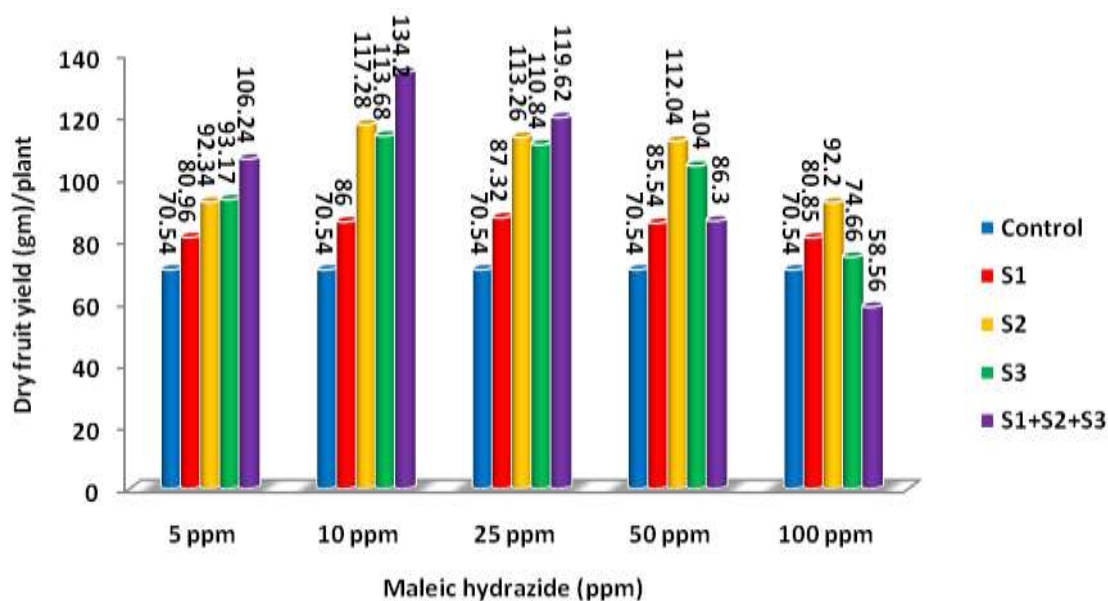


Fig – 2 : Effect of maleic hydrazide on dry fruit yield / plant in chilli

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