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Research Article

Comparative Effect of Different Concentration of Salicylic Acid and IBA on the Growth, Yield and Quality of Garlic

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A B S T R A C T

The present study was conducted to study the effect of salicylic acid and indole butyric acid on growth, yield and quality of garlic. An experiment was conducted at National Tea and High Value Crops Research Institute, Shinkiari. The experiment was laid with both designs RCBD for growth and yield and CRD for quality parameters. Different concentration of indole butyric acid and Salicylic acid were used i.e. 60mg/l, 120mg/l and 180mg/l. In interaction between salicylic acid and indole butyric acid, maximum plant height, No of leaves per plant and leave length (72.42 cm) (10.56) (39.43 cm) was recorded in plants treated with salicylic and indole butyric acid at the rate of 180 mg/l and 90 mg/l respectively whereas minimum plant height (58.34 cm) (5.28) (28.26 cm) was noted in control plot when treated with salicylic acid at the rate of 60 mg/l., maximum bulb weight and bulb diameter (88.78 g) (65.35 mm) was recorded when both indole butyric acid and salicylic acid were applied to the plant at the rate of 90 and 180 mg/l, respectively, whereas minimum bulb weight and Bulb diameter (75.35 g) (55.24 mm) was noted in plants when only salicylic acid is applied at the rate of 60 mg/l. Maximum TSS was recorded in bulb treated with SA. Highest free amino acid was recorded in the garlic treated with IBA. Terpenoids and Flavonoids were found positive in all applied concentration of garlic while Steriods were found negative. Glycosides were found negative in 60mg/l IBA while present in all others. Alkaloids were found negative in all concentration of IBA and 60mg of SA while present in 120, 180mg/lSA.

Keywords: Indole Butyric Acid, Salicylic Acid

Introduction

Garlic most widely spread and cultivated to be a popular crop after the union (Rochecouste, 1984) It is originated from arid and semi-arid region of central Asia (Etoh and Simon, 2002). Most of the time garlic is utilized for home use in different form for cooking purposes either as sauces or

zest. It has incredible significance in light of its therapeutic esteem and is utilized for treating different cardiovascular and stomach diseases, sore eyes, ear infection and it contains extensive quantity of minerals and vitamins (Kumar et al. 2010; Mengesha and Azene, 2015). In Overall garlic is cultivated on an area of 2.5 million acre with aggregate production of 25 million tons. China is the main garlic producing country which contributes 80 % to the aggregate world production (FAO, 2014). Pakistan, it is grown at an area of 172.4 thousand acre with an aggregate production of 1698.1 thousand tons every year with average yield of 9 tons per acres which is quiet low as compared to an average yield of other garlic growing countries of 19 ton per acre (GOP, 2012).

Non availability of promising varieties, poor production package and lack of sensitive market are major bottleneck in lower production of garlic. Plant growth regulators can be successfully used to improve the low of garlic in our country.

Growth regulators are natural substances that improve plant growth when applied in a small amount (Naeem et al. 2004). There are various reports on the effect of plant growth regulators that some can be used to improve the productivity of different crops (Andus, 1972; Bhardwaj and Dau, 1974; Tiliberg, 1977). Several pathways have revealed that pretreatment of plant growth regulators can lead to an increase in tissue hydration, redistribution of nutrient reserves and higher respiratory activities and promotion of seed growth, dry matter production, early flowering and yield (Abraham and Attanga, 1981; onyebunchi, 1981, Chiba and Lal, 1988; Shane et al. 1988).

Indole acid-3-froth (IBA) is a plant growth promoter, used to accelerate and regulate the formation of roots in young plant seedlings and promote crop growth and productivity.

Early root initiation was noticed when IBA was applied in contrast to untreated plants of date-palm(Afzal et al., 2011) Application of IBA gave significant results as compared with control in factual investigation of every single recorded parameter i.e., length of root, number of leaves, fresh weight of plant, height of the plant, diameter and length of the bulb, length of the clove, fresh and dry weight of root, brix, anthocyanin, yield of allicin and total yield of the bulb (Bideshk and Arvin, 2013).

Keeping in view the nutritional and medicinal value of garlic, it is imperative to improve the quality and production of garlic. In this regard plant growth regulators are very important in improving the yield and quality of garlic. So this experiment is carried out to find out the impact of indole butyric acid on the growth, yield and quality of single clove garlic.

Material and Methods

An experiment title “effect of salicylic acid and indole butyric acid on the growth, yield and quality of garlic” was conducted at National tea and High value Crops research institute, Shinkiari, Mansehra during Rabi 2018. The experiment was designed in both complete random block design (RCBD) with a split plot arrangement containing three crop replicas, garlic growth and CRD quality. Different concentration of salicylic (60, 120 and 180 mg/l) was assigned to the main plot, whereas different concentrations of IBA (30, 60,120 mg/l) was allotted to the subplot. IBA were sprayed on garlic just 30 days after sowing and salicylic acid was sprayed 30 days later. There were nine subplot in each replication. The total experiment area was 183.5 meter square. Nitrogen and phosphorus were applied at rate 140 kg/ha and 80 kg/ha respectively. All phosphorus and half dose of nitrogen was applied at the time of sowing and the remaining nitrogen at 30-45 days after sowing. In study, data regarding plant height was recorded during growth and after harvest of crop.

Phytochemical Screening

Plants Procurement

Cloves of garlic were selected. They were skinned, washed and blot dried at room temperature. They were cut into pieces and then dried under shade for three days to remove the moisture content, then merged into smaller granules.

Extraction Method

10g of dried powdered of each sample was soaked in solvent respectively. The mixture of solvent was agitated in a mechanical shaker overnight, filtered, the filtrate was evaporated and the residues were used for phytochemical analysis and bioassay.

Test for Alkaloids

The method described by (Okwu, 2005) was used for the detection of alkaloids content in each sample of tea. 5ml of 2% HCl was added in 2ml of both ethanolic and aqueous extracts, then heated gently on steam bath and filtered by Whatman filter paper. After this 0.5 ml of Wagner’s reagent was added in 1ml of each filtrate. A reddish brown precipitate was formed which indicated the presence of alkaloids.

Test for Flavonoids

Acid-alkaline test which was described by (Osagie, 2011) was used for the determination of flavonoids presence in tea samples. A few drops of concentrated ammonia were added in two ml of aqueous extracts. Yellow colour appeared which showed the presence of flavonoids.

Test for Phenol

$FeCl_3$ test: Fewdrops of 10% aqueous $FeCl_3$was added in 2 ml of aqueous extract blue green color emerged which was the sign of phenol (Sofowora et al. 1993).

Test for Glycosides

$FeCl_3$ test: 5ml of conc. $H_2SO_4$was treated with 2 ml of of aqueous extracts, then boiled for 15minutes using a water bath. After that mixtures were cooled and 20% KOH used to neutralize the mixtures. Added few drops of $FeCl_3$into both mixtures and green to black precipitates were appeared (Sofowora et al. 1993).

Test for Steroids

H_2SO_4 test: Took 2ml of aqeuous extracts in test tubes, added 6drops of conc. H_2SO_4cautiously from the side wall of the test tube treated with was added. Red colouration showed the presence of steroids (Idu and Igeleke, 2012).

Test for Terpenoids

Salkowaki Test: 1ml of both aqueous and ethanolic extract was treated with 2ml of chloroform and added 3ml of conc. H_2SO_4. At interface reddish brown colour appeared (Sofowora et al. 1993).

Determination of Amino Acids

A colorimetric method for the quantitative analysis of pure amino acids is described (Rosen, 1957).

Statistical Analysis

Data was analyzed using statistic 8.1, statistical software for analysis of variance. Least significant difference (LSD) test was used to compare the mean of the obtained results in this research

Result and Discussion

Plant height (cm), No of Leave/ Plant, Leave Length (cm)

Salicylic acid, indole butyric acid and its interaction had significant effect on plant height, No of leave per plant and leave length (Table 1). In salicylic acid, Maximum plant height, No of Leaves/ Plant and leave Length (66.58 cm), (8.80) ,(35.58 cm) was recorded from plants treated with salicylic acid at the rate 180 mg/l whereas minimum plant height, No of leaves per plant, Leave length (63.13 cm), (6.35), (31.57 cm) was noted in plant treated with salicylic acid at the rate 60 mg/l. The salicylic acid had favorable effect on vegetative growth because it is a growth promoting chemical, as it accelerates cell division in apical portion of the plant and also due to involvement of salicylic acid in regulation of several physiological processes in plants such as stomata closure, ion uptake, inhibition of biosynthesis and transpiration (khan et al. 2003).

In case of indole butyric acid, greater plant height, No of leaves per plant and Leave length (70.44 cm), (8.96),(37.49 cm)was observed in plants treated with indole butyric acid at the rate 90 mg/l whereas less plant height (60.05 cm) (5.55) (30.38) was recorded in control plots. The increase in vegetative growth in IBA treated plants might due to the fact that it is auxin which is used to increase and accelerate root formation leading toward efficient absorption of mineral nutrients and hence increases the vegetative growth (Afzal et al. 2011, Naghmouchi et al. 2008)

In interaction between salicylic acid and indole butyric acid, maximum plant height, No of leaves per plant and leave length (72.42 cm) (10.56) (39.43 cm) was recorded in plants treated with salicylic and indole butyric acid at the rate of 180 mg/l and 90 mg/l respectively whereas minimum plant height (58.34 cm) (5.28) (28.26 cm) was noted in control plot when treated with salicylic acid at the rate of 60 mg/l.

Table 1.Plant height (cm), Leaves plant-1, Leave length (cm), bulb weight (g) and Bulb diameter (mm) as effected by different concentration of Salicylic acid and indole butyric acid

Treatments	Plant height (cm)	No of Leaves plant^{-1}	Leave length (cm)	Bulb weight (g)	Bulb Diameter (mm)
Salicylic Acid (SA)					
SA (60 mg/l)	63.13 C	6.35 C	31.57 C	79.90 C	59.17 C
SA (120 mg/l)	64.78 B	7.89 B	33.52 B	81.88 B	61.26 B
SA (180 mg/l	66.58 A	8.80 A	35.58 A	83.83 A	63.33 A
LSD	0.0548	0.0288	0.0146	0.3715	0.0192
Indole butyric Acid (IBA)					
IBA (0 mg/l)	60.05 D	5.55 D	30.38 D	77.00 D	57.32D
IBA (30 mg/l)	63.22 C	7.78 C	32.10 C	80.29 C	60.26 C
IBA (60 mg/l)	65.54 B	8.43 B	34.25 B	83.52 B	62.52 B
IBA (90 mg/l)	70.44 A	8.96 A	37.49 A	86.68 A	64.92 A
LSD	0.0479	0.0265	0.0155	0.3251	0.0133
Interaction					
SxI	Fig. 1	Fig. 2	Fig. 3	Fig. 4	Fig. 5

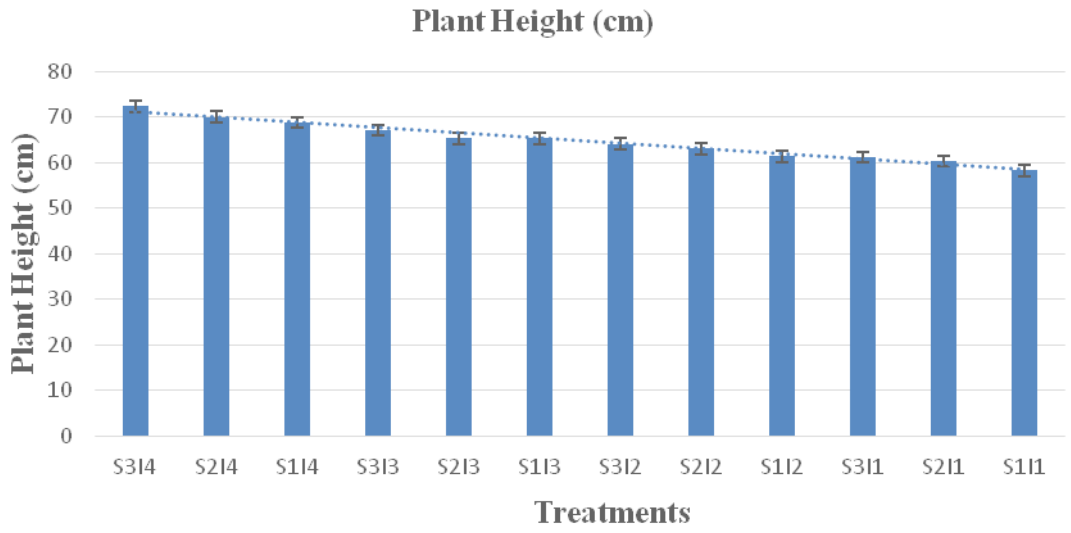

Figure 1.Interaction effect of Indole Butyric Acid and salicylic acid on Plant Height (cm)

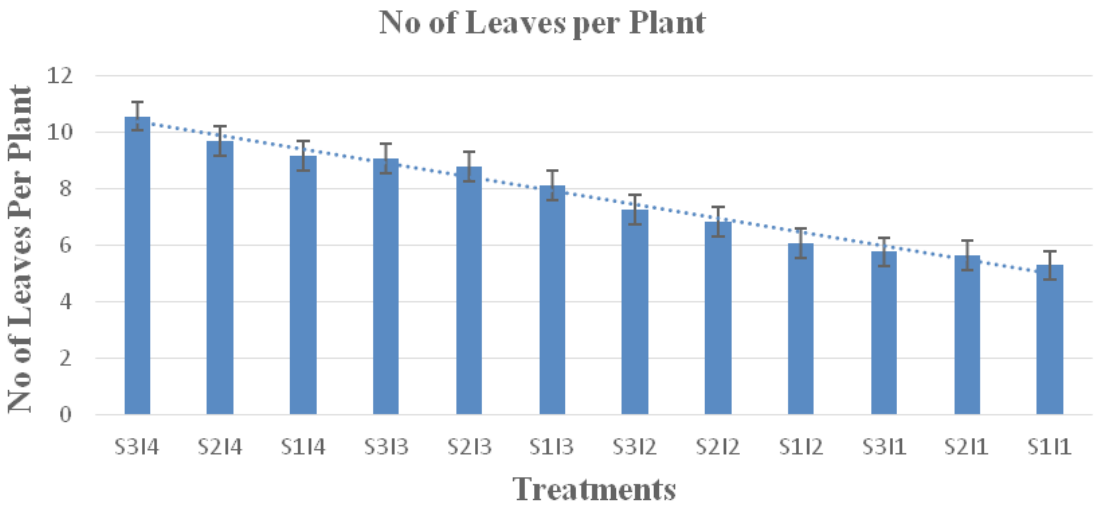

Figure 2.Interaction effect of Indole Butyric Acid and Salicylic acid on Number of Leaves per Plant

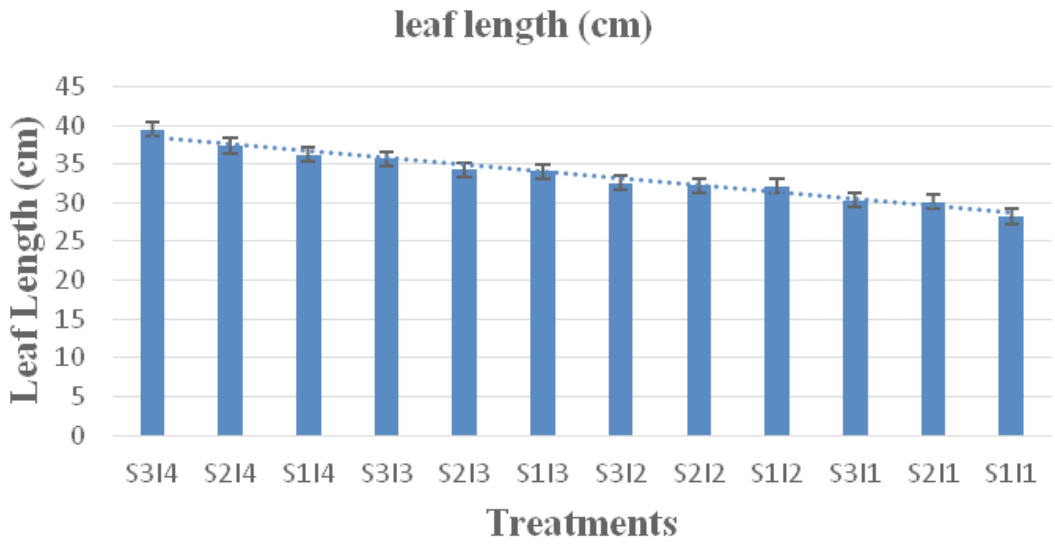

Figure 3.Interaction effect of indole butyric acid and salicylic acid on Leaf Length (cm)

Bulb weight (g) and Bulb Diameter (mm)

Salicylic acid, indole butyric acid and its interaction had a significant effect on bulb weight (g) and Bulb diameter (mm) (Table-1). In salicylic acid, more bulb weight and Bulb diameter (83.83 g) (63.33 mm) was obtained from plants treated with salicylic acid at the rate of 180 mg/l, whereas less bulb weight and bulb diameter (79.90 g) (59.17 mm) was noted in plants where salicylic acid were applied at the rate of 60 mg/. This may be due to the effectiveness of better photosynthesis with the application of SA and increase chlorophyll leaves content Amin et al, 2007).

In case of indole butyric acid, highest bulb weight and Bulb diameter (86.68 g) (64.92 mm) was observed in plots where plants were treated with indole butyric acid at the rate of 90 mg/l whereas lowest bulb weight and bulb diameter (77.00 g) (57.32 mm) was obtained from untreated plots. It may be due to the fact that indole Butyric Acid hastens cell division and elongation which resulted in increases in bulb weight and diameter (Imtiaz et al. 2019). In case of interaction between salicylic acid and indole butyric acid, maximum bulb weight and bulb diameter (88.78 g) (65.35 mm) was recorded when both indole butyric acid and salicylic acid were applied to the plant at the rate of 90 and 180 mg/l respectively whereas minimum bulb weight and Bulb diameter (75.35 g) (55.24 mm) was noted in plants when only salicylic acid is applied at the rate of 60 mg/l.

Figure, Effect of different concentration of IBA on Bulb size

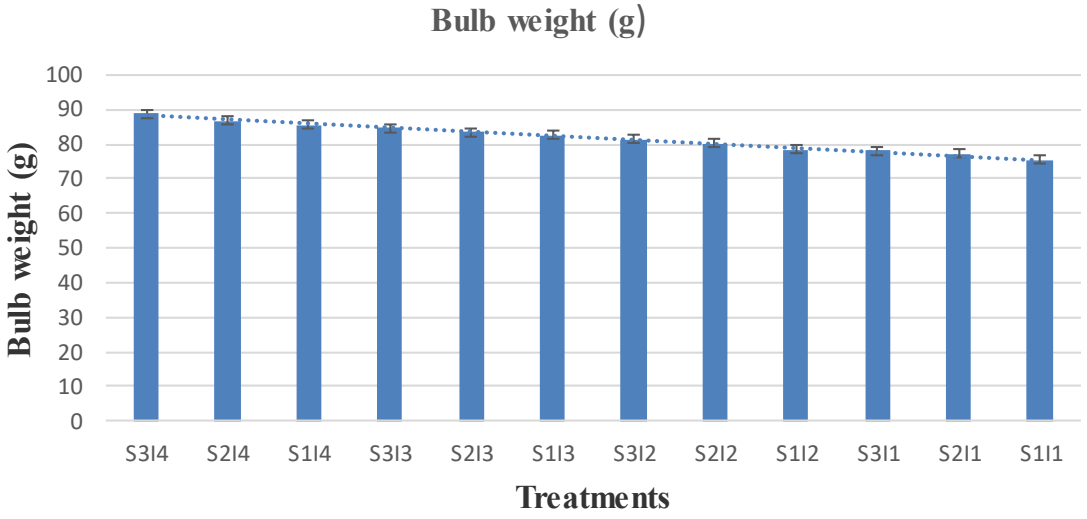

Figure 4.Interaction effect of indole butyric acid and salicylic acid on bulb weight (g)

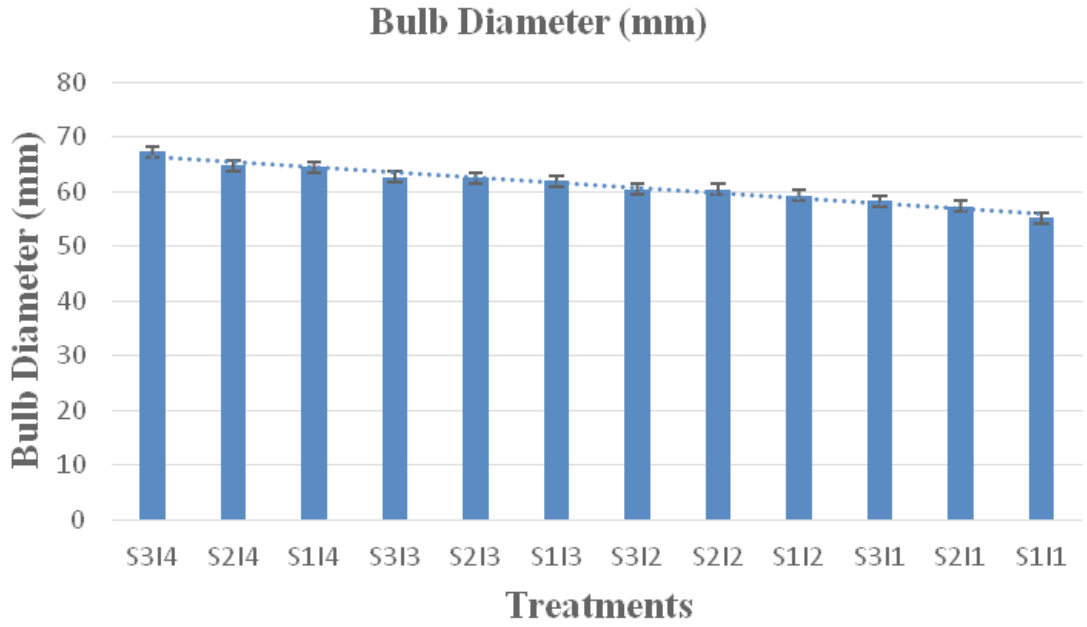

Figure 5.Interaction effect of Indole butyric acid and salicylic acid on Bulb Diameter (mm)

No of Clove Per Bulb

Analysis of the data indicated that salicylic acid, indole butyric acid and interaction of salicylic acid and indole butyric acid had significant effect on number of clove per plant (Table-2). In case of salicylic acid, more cloves per bulb (11.99) were obtained from plants treated with salicylic acid at the rate of 180 mg/l whereas less clove per bulb (10.21) was noted in plants treated with salicylic acid at the rate of 60 mg/l. it might be due to increase water use and carboxylation efficiency in association with high photosynthetic rate induced by Salicylic acid. Also salicylic acid increases ion uptake, control stomata function and gravity sensing and pathogenesis (Lucas and Lee, 2004).In case of indole butyric acid, highest clove per bulb (12.70) was noted in plants treated indole butyric acid at the rate of 90 mg/l whereas lowest clove per bulb (9.29) was obtained from untreated plants. In case of interaction between salicylic acid and indole butyric acid, more clove (13.73) was obtained when both salicylic and indole butyric acid was applied at the rate of 180 and 90 mg/l whereas less clove (8.76) was recorded from plants when only salicylic acid was applied at the rate of 60 mg/l.

Clove Weight (g)

Salicylic acid, indole butyric acid and its interaction had significant effect on clove weight (g) (Table-2). In case of salicylic acid, maximum clove weight (9.26 g) was obtained from plants treated with salicylic acid at the rate of 180 mg/l whereas minimum clove weight (8.36 g) was recorded from plants treated with salicylic at the rate 60 mg/l. in case of indole butyric acid, highest clove weight (9.69 g) was noted from plants treated with indole butyric acid at the rate of 90 mg/l whereas lowest clove weight (7.71 g) was observed from untreated plots. In case of interaction between salicylic acid and indole butyric acid, maximum clove weight (10.26 g) was obtained from plants when both salicylic acid and indole butyric acid was applied at the rate 180 and 90 mg/l whereas minimum clove weight (7.56 g) was obtained from plants when only salicylic acid was applied at the rate of 60 mg/l.

Table 2.Clove bulb-1, clove weight (g), Bulb yield (t ha-1), as effected by different concentration of salicylic acid and indole butyric acid

Treatments	No of Clove bulb^{-1}	Clove weight (gram)	Bulb Yield t ha^{-1}
SA (60 mg/l)	10.21 C	8.36 C	10.88 C
SA (120 mg/l)	11.09 B	8.78 B	11.63 B
SA (180 mg/l	11.99 A	9.26 A	12.41 A
LSD	0.0117	2.6253	0.1867
Indole Butyric acid			
IBA (0 mg/l)	9.29 D	7.71 D	9.49 D
IBA (30 mg/l)	10.81 C	8.66 C	11.44 C
IBA (60 mg/l)	11.59 B	9.13 B	12.47 B
IBA (90 mg/l)	12.70 A	9.69 A	13.17 A
LSD	3.0776	3.6253	0.2323
Interaction			
SxI	Fig. 6	Fig. 7	Fig. 8

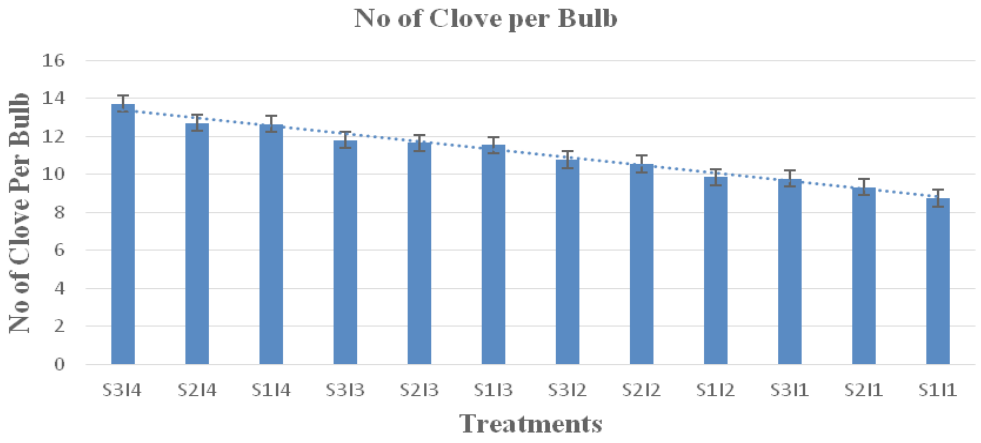

Figure 6.Interaction effect of indole butyric acid and salicylic acid on No of Clove per Bulb

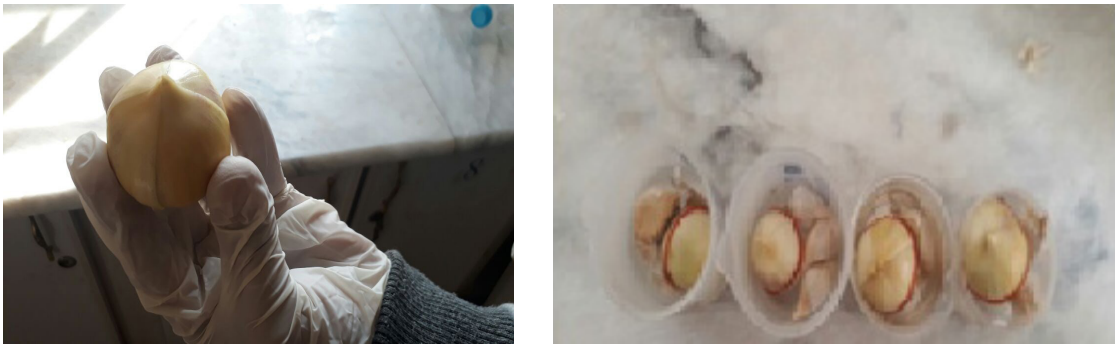

Figure. Effect of different concentration of Salicyclic acid on clove weight

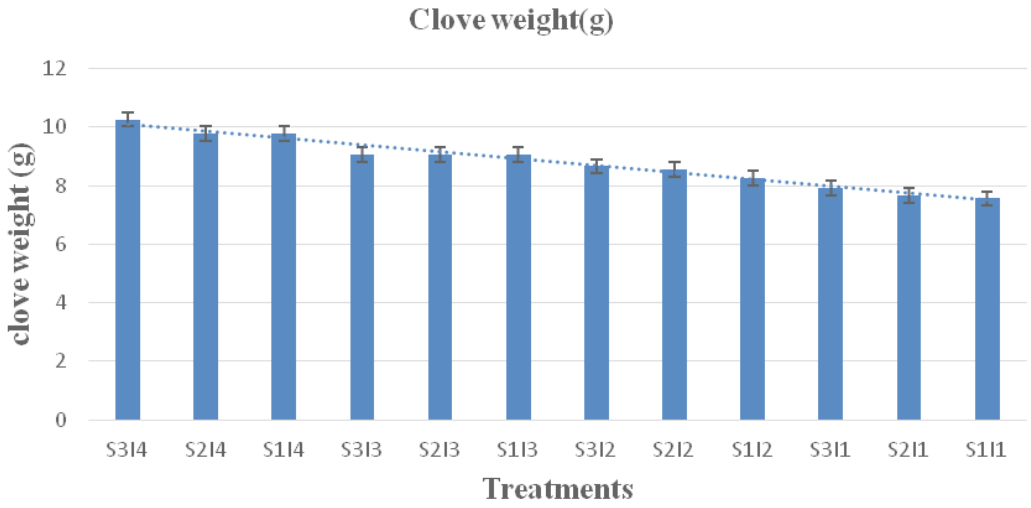

Figure 7.Interaction effect indole butyric acid and salicylic acid on clove Weight (g)

Bulb Yield (t ha-1)

Analysis of the data indicated that salicylic acid, indole butyric acid and its interaction had significant effect on bulb yield (t ha-1) (Table-2). In case of salicylic acid, highest bulb yield (12.41 t ha-1) was recorded from plants treated with salicylic acid at the rate of 180 mg/l whereas lowest bulb yield (10.88 t ha-1) were obtained from plants treated with salicylic acid at the rate 60 mg/l. in case of indole butyric acid, maximum bulb yield (13.17 t ha-1) was recorded from plants treated indole butyric acid at the rate of 90 mg/l whereas minimum bulb yield (9.49 t ha-1) was obtained from untreated plants. In case of interaction between salicylic acid and indole butyric acid, maximum bulb yield (13.92 t ha-1) was obtained when both salicylic acid and indole butyric acid were applied at the rate of 180 and 90 mg respectively whereas minimum bulb yield (9.16 t ha-1) was recorded from plants when only salicylic acid was applied at the rate of 60 mg/l.

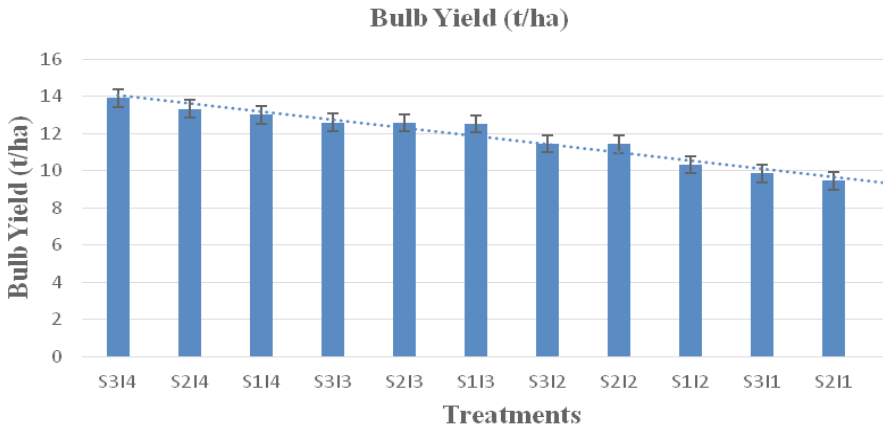

Figure 8.Interaction effect of Indole Butyric acid and salicylic acid on Bulb yield (t/ha)

TSS (%)

Salicylic acid, indole butyric acid and its interaction had significant on TSS (%) (Table-2). In case of salicylic acid, highest TSS (12.83 %) was recorded from bulbs which were treated with salicylic acid at the rate of 180 mg/l whereas lowest TSS (11.93 %) was noted from bulb which was treated with salicylic acid at the rate of 60 mg/l. In case of indole butyric acid, maximum TSS (14.16 %) was noted from bulb treated with IBA at the rate of 90 mg/l whereas minimum TSS (10.55 %) was obtained from bulb of untreated plants. In case of interaction between salicylic acid and indole butyric acid, maximum TSS (14.66 %) was recorded from plants treated with both salicylic acid and indole butyric acid at the rate 180 and 90 mg/l whereas minimum TSS (10.23 %) was obtained from plants treated with salicylic acid at the rate of 60 mg/l.

Free Amino Acid (mg/100 gram)

Free amino acid was significantly effect by salicylic acid, indole butyric acid and their interaction (Table-2). In case salicylic acid, maximum free amino acid (75.21 mg/100 gram) was recorded from plants treated with salicylic acid at the rate of 180 mg/l whereas minimum free amino acid (72.25 mg/100 gram) was obtained from plants treated with salicylic acid at the rate of 180 mg/l. In case of indole butyric acid, highest free amino acid (77.56 mg/100 gram) was obtained from plants treated with indole butyric acid at the rate of 90 mg/l whereas lowest free amino acid (69.21 mg/100 gram) was obtained from untreated plants. In case of interaction between salicylic acid and indole butyric acid, maximum free amino acid (79.06 mg/100 gram) was obtained from plants where both salicylic acid and indole butyric acid was applied at the rate of 180 and

Table 3.TSS (%) and free amino acid (mg/100 gram) as effected by different concentration of salicylic acid and indole butyric acid

Treatments	TSS (%)	Free Amino acid (mg 100 gram^{-1})
SA (60 mg/l)	11.93 C	72.25 C
SA (120 mg/l)	12.38 B	73.70 B
SA (180 mg/l	12.83 A	75.21 A
LSD	0.0135	2.8103
Indole butyric Acid (IBA)		
IBA (0 mg/l)	10.55 D	69.21 D
IBA (30 mg/l)	11.86 C	72.92 C
IBA (60 mg/l)	12.95 B	75.19 B
IBA (90 mg/l)	14.16 A	77.56 A
LSD	1.7953	3.0836
Interaction		
SxI	Fig. 9	Fig. 10

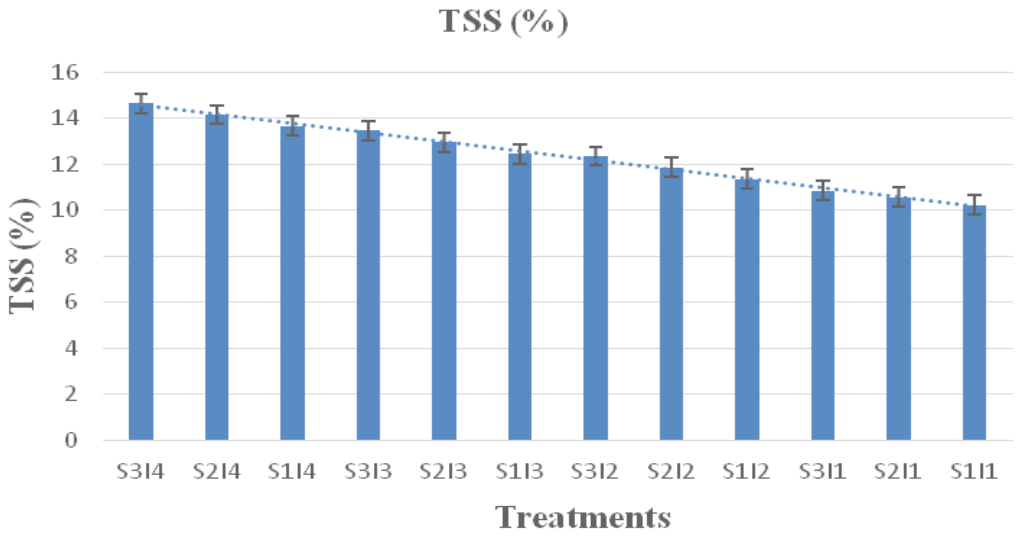

Figure 9.Interaction effect of Indole Butyric acid and Salicylic Acid on TSS (%)

90 mg/l whereas minimum free amino acid (68.23 mg/100 gram) was obtained from plants treated with salicylic acid at the rate of 60 mg/l.

Phytochemical Screening

Secondary metabolites have the medicinal and physiological activity (Edeogal et al. 2005). The phenolic compounds are considered to beone of the maingroups of plant metabolites (Singh et al. 2007). This analysis was performed to check out the phytochemical profile in garlic against different concentration of salicylic acid and iodole butyric acid. Different concentration of indole butyric acid and salicylic acid were applied to garlic i.e. 60mg\l, 120mg/l and 180mg/l. Terpenoids and Flavonoids were found positive in all applied concentration of garlicwhile Steriods were found negative. Glycosides were found negative in 60mg/l IBA while present in all others. Alkaloids were found negative in all concentration of IBA and 60mg of SA while present in 120, 180mg/LSA

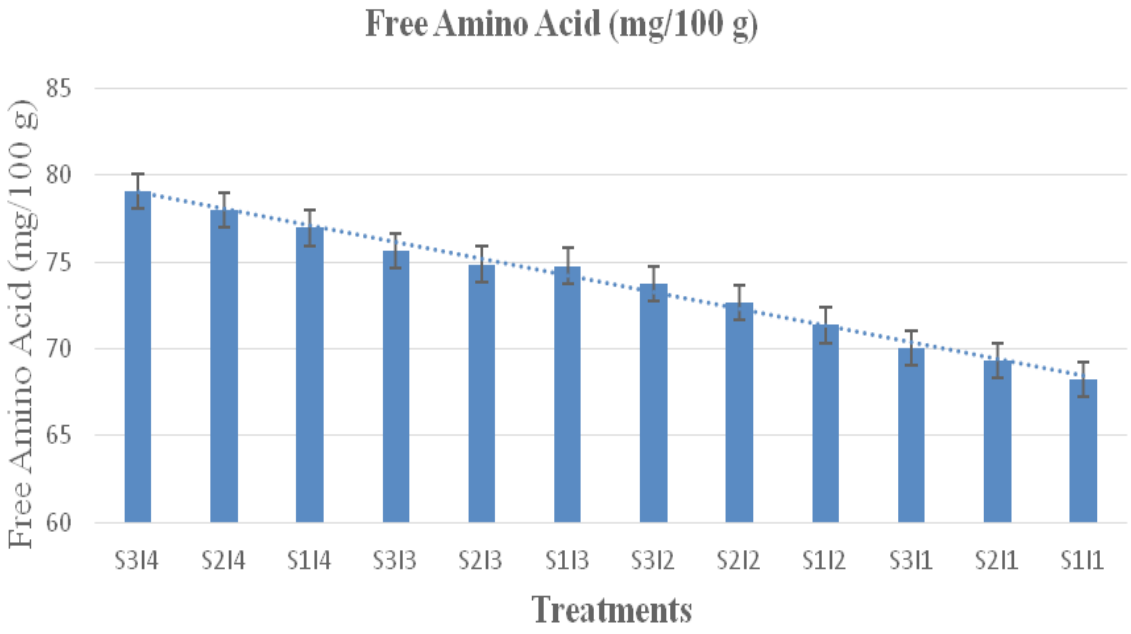

Figure 10.Interaction effect of Indole butyric acid and salicylic acid on free Amino Acid (mg/100 g)

Table 4.Phytochemical Profile of different concentration of salicylic acid on garlic

Phytochemical Constituents	SA 60mg/l	SA 120mg/l	SA 180mg/l
Terpenoids	+	+	+
Steroids	-	-	-
Glycosides	+	+	+
Flavonoids	+	+	+
Alkaloids	-	+	+

Table 5.Phytochemical Profile of different concentration ofIndole butyric acid on garlic

Phytochemical Constituents	IBA 60mg/l	IBA 120mg/l	IBA 180mg/l
Terpenoids	+	+	+
Steroids	-	-	-
Glycosides	-	+	+
Flavonoids	+	+	+
Alkaloids	-	-	-

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