Studies on seed treatment with GA and NAA, and their residual effect on growth, yield and Quality of Okra *(Abelmoschus esculentus* (L.) Moench)

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BY

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C E R T I F I C A T E

This is to certify that this Thesis entitled "Studies on seed treatment with GA and NAA, and their residual effect on growth, yield and quality of Okra (*Abelmoschus esculentus* (L) Moench)" submitted for the Degree of M.Sc.(Agriculture) in the major subject Horticulture, of Andhra Pradesh Agricultural University, is a result of bonafide research work carried out by Sri Mohammed Arifuddin, under my supervision and that the thesis has not formed in whole or in part the basis for the award of any degree, diploma, or other similar degree or distinction.

The assistance and help received during the course of investigation have been fully acknowledged.

21/5/77

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C O N T E N T S

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INTRODUCTION

The efficacy of plant growth regulators, applied either through seed treatment or as whole plant spray, in increasing plant growth, yield and quality in vegetables has been proved beyond doubt. But the application of these potent chemicals at appropriate concentrations requires care and technical knowledge. As such, many of the useful results obtained by scientists at research stations do not easily lend themselves for adoption by the farmer because of the difficulties involved in handling these potent chemicals and in the preparation of correct concentration and application at appropriate time. Many research workers have reported that the use of growth regulators for seed treatment has resulted in increased yields. But no work seems to have been done to explore the possibility of pre-treating the seed and keeping it for some time without loss of viability before it is distributed to the farmer. Hence the present studies were designed to go into this aspect and an experiment was conducted in the College Farm of Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad during the summer season of 1976, to study the effect of GA and NAA at different concentrations and the treated seed was stored for different periods before sowing to assess the residual effect of these chemicals on various aspects of plant growth, yield and quality of fruits in Okra variety Pusa Sawani.

REVIEW OF LITERATURE

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Since the discovery of plant growth regulators, efforts have been made for exploitation of their effects for increasing the crop production. Many growth regulating chemicals have been found useful to increase the percentage of germination and enhance plant growth and yield by seed treatment. The available literature on this aspect is reviewed hereunder with special reference to vegetable crops.

Seed Germination:

Several workers studied the effect of seed treatment with plant growth regulators on germination.

Sunder Raj and Muthukrishnan (1965) reported 100% seed germination in Okra seed soaked in Gibberellic Acid. Srivastava (1966) observed maximum percentage of germination when Bhendi seeds were soaked in 0.5 ppm of 2,4-D but its higher concentration reduced germination. He further observed that treatment with NAA at 25, 50 and 100 ppm increased the percentage of germination, but 200 ppm concentration was toxic. Srivastava and Singh. et al.(1968) found that GA at 10, 30 and 50 ppm and NAA at 25, 50 and 75 ppm significantly increased germination over control. Ahmed (1968) obtained 19.17% increased germination over control when the seeds were treated with 100 ppm GA.

Soaking of bhendi seeds in 10, 50, 100 and 200 ppm of GA and NAA, increased germination percentage (Paul et al. 1969), Nandpuri et al.(1969) reported an increase in the germination of bhendi seeds soaked in 1 ppm of GA and NAA for 8 hours, but GA treatments were superior to IAA. Improved germination was obtained when the seeds of Okra were soaked in a solution of IAA and GAg at 25, 50, 75 and 100 ppm for 24 hours (Srivastava and Sachan et al.1971). Singh et al.1973 reported maximum germination when Okra seeds were treated with GA at 25, 50, 75 and 100 ppm concentrations, but 2,4-D was found to be toxic. Vasant Rao (1974) recorded maximum germination with 150 ppm GA followed by 100 ppm GA and 25 ppm NOA. Pissani (1969) studied the effect of GA on seed treatment of spinach, egg plant, lettuce, radish, bean, carrot and onion, and concluded that it had a favourable effect on rate and percentage of germination in egg plants only. Choudhury and Singh (1960) reported increased percentage of germination of tomato seed treated with NAA at 25 and 50 ppm concentration. Adalka and Verma et al.(1965) working on tomato reported an increase in the percentage of germination when seeds were soaked in 1 ppm GA or NAA but 10 ppm had an inhibiting effect. Srivastava (1963) studied the effect of plant growth regulators and (IAA, IPA, GA) on tomato seeds and reported the highest germination percentage of

96.66 with 50 ppm GA followed by 10 ppm NPA. Wittwer and Bukovac et al.(1957) obtained increased germination in peas and beans treated with GA. Lona (1957) also reported an increase in the germination of lettuce seed with 0.02% and 0.04% of GA. Hussani et al.(1968) found that seed soaking in GA did not alter the percentage of germination in tomato. According to Bhat (1963) NAA at 100 ppm increased the germination in carrot but higher concentration had a decreasing effect. Sadawarte and Gupta (1968) observed that when brinjal seeds were soaked in various concentration of IAA, NAA, GA and NPA for 24 hours, GA concentration of 5, 10, 20 and 40 and IAA and NAA at 5 and 10 ppm increased the percentage of germination. Maier et al.(1962) recorded an increase in the rate of germination when bean and spinach seed were treated with GA Srivastava et al.(1960) found an increase in germination with NAA in onion, garlic and peas.

Vegetative Characters:

Mandpuri et al.(1969) concluded that treatment of Okra seeds with GA at 100 and 200 ppm was effective in increasing the plant height and 2,4-D at 5 and 10 ppm depressed the growth. According to Pal et al.(1969) seed treatment of bhendi with NAA 500 ppm resulted in maximum number of branches. Treatment of Okra seed with 10, 20,

40 and 80 ppm of GA and MH resulted in increased plant height, number of leaves and shoot to root ratio, and MH stumulated branching. Das and Pattanaik et al.(1971) reported that GA_3 treatment resulted in improved germination and growth and yield. Srivastava (1960) reported that GA at 10 and 50 ppm and NAA at 10, 50 and 100 ppm caused significantly better growth than in control. Choudhry and Singh (1960) also observed increased plant growth by soaking tomato seed in 25 and 50 ppm of NAA for 24 hours. Kentzer (1960) observed that when lettuce seed were soaked in 0.001% GA solution shoot growth was stimulated. Maier et al.(1962) reported that seed treatment induced elongation of stem in bean and lettuce. Adalka et al.(1965) recorded increase in plant height, number of leaves and number of branches when seeds were treated with NAA 1 ppm and GA 10 ppm. Brown et al.(1968) obtained the tallest tomato seedling from the seed treated with GA. Bose et al.(1968) observed an accelerated growth in tomato stem and leaves by treating the seeds with 5 ppm GA. Sadawarte and Gupta et al.(1968) found that presowing treatment of brinjal seed with 50 ppm IAA produced the tallest plants. Choe (1972) reported enhanced growth and chlorophyll content in pea seedlings when seeds were treated with GA and IAA at 0.1 mg per letre concentration.

Floral Characters:

According to Nandpuri et al.(1969) seed treatment of Okra with 100 ppm GA resulted in significant increase in flower formation. Pal et al.(1970) recorded maximum number of flowers per plant when Okra seeds were treated with 400 ppm NAA. Das et al. and Pattanaik (1971) observed early flowering in Okra when seed were treated with GA. Das et al. and Pourly (1969) reported in egg plants that seed soaking with 10, 50 and 100 ppm GA resulted in a significant reduction in the number of days for flowering. Adalka et al.(1965) observed considerable reduction in the time required for commencement of flowering in tomato if seeds were treated with 1 ppm GA and NAA. Sadawarte and Gupta (1968) reported hastening of flowering and increased number of flowers in brinjal when seeds were treated with 10, 20 and 40 ppm of GA and 5 or 10 ppm NAA.

Fruit Characters:

Srivastava and Sachan (1965) reported significantly higher yield with 25, 50, 75 and 100 ppm GA as seed treatment in bhendi. Rao (1966) reported an increase in early yield of bhendi due to seed treatment with GA 50 ppm. It was concluded that 50 to 100 ppm GA might be successfully used for increasing the yield in bhendi. Srivastava and Singh (1968) concluded that the yield of bhendi could be considerably increased by pre-sowing seed treatment

with GA 10 ppm and NAA 50 ppm. Mandpuri et al.(1969) observed that seed treatment with 100 ppm GA increased the yield of bhendi. Pal et al.(1970) found that soaking of bhendi seeds in solutions of 50, 100, 200 and 400 ppm of GA, IAA and NAA had a beneficial effect on yield, and NAA at 400 ppm gave the maximum yield. Das & Pattanaik et al.(1971) reported that when bhendi seeds were treated with GA 20 or 40 ppm, higher yields were obtained as compared to control. Srivastava et al.(1971) observed that seed treatment of bhendi with GA_3 and IAA at 25, 50, 75 ppm was effective in improving the yield. Choudhury and Singh (1960) also observed significant increase in yield of tomato if seeds were soaked in 25 or 50 ppm of NAA. Adalka et al.(1965) reported an increase in the yield of tomato per plant when seeds were treated with 1 ppm NAA and 10 ppm GA. Das and Purkayastha et al.(1969) recorded the highest yield of brinjal when seeds were treated with 50 ppm GA, whereas MH reduced the yield as compared to control. Srivastava (1967) found that pre-sowing treatment of seed with GA 20 ppm or with NAA 150 ppm was most satisfactory. Srivastava 1960 recorded maximum yield of tomato when seeds were treated with 50 ppm GA followed by 75 ppm NAA. These treatments increased the yield three-fold as compared to control.

Srivastava and Singh (1968) reported that the number of pods in bhendi plant was significantly increased when its seeds were treated with 10, 30 and 50 ppm of GA and concluded that maximum number of pods per plant could be obtained with 10 ppm GA. Pal et al.(1970) observed that when bhendi seeds were treated with 10, 50, 100 and 200 ppm of GA and NAA there was significant increase in number of pods per plant. Das and Pattnaik (1971) reported increased number of fruits per plant when bhendi seeds were treated with 10, 20, 40 and 80 ppm of GA. Increased number of pods per plant was recorded by Srivastava and Bajpai (1967) by seed trial with GA. Das et al.(1969) also recorded similar result with GA seed treatment in brinjal.

Srivastava and Singh (1968) recorded significant increase in length and diameter of pod in bhendi with 10, 30 and 50 ppm of GA and 25, 50 and 75 ppm of NAA. Mandpuri et al.(1969) found that GA treatment of bhendi seeds at 200 ppm and PA at 50 ppm increased pod length. Increased pod size in peas was obtained by treating the seeds with 10 ppm GA and 150 ppm NAA. Srivastava and Bajpai (1967) and Sadawarte and Gupta (1968) reported an increase in fruit size when brinjal seeds were treated with 5, 10, 20 and 40 ppm of GA and NAA. Srivastava (1963) observed

increased diameter of tomato fruit when seeds were pretreated with 75 ppm NAA.

Srivastava (1960 and 1964) found reduced number of seeds per fruit in tomato when seeds were treated with 75 and 100 ppm NAA and 50 ppm GA. Sadwarte and Gupta (1968) recorded less number of seeds in brinjal with 5, 10, 20 and 40 ppm GA and NAA. Srivastava (1963) reported that 75 ppm NAA caused partial parthenocarpy and the lowest number of seeds was recorded with 50 ppm NAA in tomato.

Fruit Quality:

Gaskin (1968) found no differences in vitamin-C content when seeds were treated with GA at 0.04%. Contrary to this, Srivastava et al.(1964) recorded increased vitamin-C content in tomato by 10, 20, 40 ppm GA and 25, 50 and 75 ppm of NAA. They also reported similar increase in peas with 10 and 20 ppm GA and in Chillies with 10, 30 and 50 ppm GA and 25, 50 and 75 ppm NAA. Srivastava and Bajpai (1967) recorded similar results with 10 ppm GA and 150 ppm NAA.

Dry matter content of fruit:

Das and Pattnaik (1971) reported significant increase in dry matter accumulation in bhendi plants by 10, 20, 40 and 80 ppm GA treatments. Significant increase

in the dry matter production in onion was reported by Vaish (1968) with 1 ppm NAA. Adalka and Verma (1965) reported increased dry weight of shoot and root in tomato with GA and NAA at 10 and 20 ppm.

N, P and K content of fruit:

Rao (1966) observed that seed treatment with 2,4-D (5-10 ppm) produced fruit with heigher percentage of Nitrogen and Phosphorus and GA treatment at 25 and 50 ppm resulted in maximum Potassium content.

The foregoing review is concerned with the effect of seed treatment with growth regulants and sowing of seed immediately after soaking in growth regulator solutions. But the effect of storing the treated seed for some time before sowing, on the plant growth and yield does not seem to have been investigated in any of the vegetable crops.

MATERIAL AND METHODS

The investigation was undertaken to study the residual effect of plant growth regulators on seeds treated and stored for different periods (0, 15 and 30 days).

Certified seeds of bhendi variety Pusa Sawani were obtained from National Seeds Corporation, Hyderabad.

Concentration of Chemicals:-

GA	50 ppm	NAA	10 ppm
GA	100 ppm	NAA	20 ppm
GA	150 ppm	NAA	40 ppm

Seed Treatment:-

Seeds were soaked for 12 hours, 30 days and 15 days before sowing and a 3rd set of seed on the same day of sowing. The treated seeds were dried under shade and stored.

Control seeds were soaked in distilled water for 12 hours.

The trial was laid out in a randomised block design replicated four times and the details of treatments are as follows:

T_1	GA	50 ppm	0 days	T_{10}	NAA	10 ppm	0 days
T_2	GA	50 ppm	15 days	T_{11}	NAA	10 ppm	15 days
T_3	GA	50 ppm	30 days	T_{12}	NAA	10 ppm	30 days
T_4	GA	100 ppm	0 days	T_{13}	NAA	20 ppm	0 days
T_5	GA	100 ppm	15 days	T_{14}	NAA	20 ppm	15 days
T_6	GA	100 ppm	30 days	T_{15}	NAA	20 ppm	30 days
T_7	GA	150 ppm	0 days	T_{16}	NAA	40 ppm	0 days
T_8	GA	150 ppm	15 days	T_{17}	NAA	40 ppm	15 days
T_9	GA	150 ppm	30 days	T_{18}	NAA	40 ppm	30 days

T_{19} Soaked in Distilled Water on the same day of sowing (control).

Preparation of the field:

Well decomposed farm yard manure was applied in the field at the rate of 40 tonnes per hectare before last ploughing.

The net plot size was 15.75 Sq.meters and manures were applied as recommended by Nawalkar et al (1962)[at] 40, 20 and 20 kgs. of NPK per acre in the form of urea, superphosphate and muriate of potash, respectively.

Urea was applied in two equal split doses (½ as basal dressing) before sowing along with the full doses of Phosphatic and Potassium fertilizers and the remaining ½ one month after sowing.

Fig(1) Layout Plan of Experimental Field

R1		R1I		R1II		R1V	
T_2	T_{19}	T_9	T_2				
T_6	T_5	T_{12}	T_{18}				
T_1	T_{10}	T_2	T_6				
T_{11}	T_{14}	T_{16}	T_{14}				
T_8	T_{17}	T_{14}	T_{12}				
T_4	T_{11}	T_8	T_{13}				
T_{12}	T_8	T_{15}	T_{16}				
T_7	T_{15}	T_4	T_{19}				
T_{17}	T_{18}	T_5	T_3				
T_{16}	T_{16}	T_{11}	T_1				
T_{14}	T_4	T_{18}	T_9				
T_{15}	T_5	T_{19}	T_{10}				
T_3	T_9	T_{18}	T_{17}				
T_{13}	T_1	T_1	T_5				
T_{10}	T_2	T_3	T_{15}				
T_9	T_{12}	T_7	T_4				
T_{12}	T_3	T_6	T_8				
T_5	T_{13}	T_{10}	T_{11}				
T_{18}	T_7	T_{17}	T_7				

N

Design- RBD

Replications - Four.

Treatments - Nineteen.

Gross plot size= 5 x 4

= 20 Sq.meters.

Net plot size = 4.5x3.5

= 15.75 Sq.meters.

Two seeds were sown per hill with a spacing of 15 cm within the row and 45 cm between the rows and the plot was irrigated immediately after sowing. Subsequent irrigations were given at 4 days interval. Thinning was done 15 days after germination leaving a single plant at each hill. As a preventive measure, the crop was sprayed with 0.02% endrin and 0.04% Parathion at regular intervals, uniformly in all treatments.

RECORDING OBSERVATIONS:

Germination Test:

One hundred seeds from each treatment were seperately tested for germination and expressed as percentage.

Vegetative Characters:

Plant Height:

This was measured in centimeters at fortnightly intervals starting from 30 days after sowing, taking 5 plants at random from each treatment.

Number of Leaves:

Number of fully opened leaves per plant were recorded at the end of the experiment in 10 of the plants selected at random in each plot.

Number of Branches:

Number of branches were also recorded in 5 plants randomly selected at the end of the experiment.

Number of nodes per plant:

Number of nodes in each of the 10 plants selected at random was recorded at the end of the experiment.

Internodal Length:

The distance between 5th and 6th nodes was measured in centrimeters from 5 plants randomly selected in each treatment.

Diameter of the Stem:

Diameter of the stem at the base was measured in centimeters.

Floral Characters:

Flowering:-

The date of opening of the first flower was recorded in each plot and the period between this date and the date of sowing was taken as number of days required for flowering.

Fruit Characters:-

Length and Breadth of Pods

Five flowers were labelled in 5 of the plants selected at random in each plot and the pods obtained from them were harvested on 6th day after flowering for measuring their length and breadth in centimeters with the help of scale and a vernier callipers.

Yield:-

Weight and number of pods were recorded per plant as well as per plot.

Number of seeds per pod:-

Pods from fixed node number were selected at random in each plot and were allowed to dry on the plant itself and the number of seeds was counted.

Fruit Quality:-

Vitamin-C (Ascorbic acid content):

Ascorbic acid content in fruits was determined, by the method of AOAC (1960) and reported in mg per 100 grams of fruit sample.

Dry matter content of fruit:-

Five fruits from each plot were randomly selected from each plot, the fresh weight was determined and fruits were oven dried at a temperature of 105°F untill a constant weight was attained to calculate the percentage of dry matter.

N, P and K content of fruit:-

Composite fruit samples were powdered and used for the analysis of Nitrogen, Phosphorus and Potassium.

Nitrogen was estimated in duplicate samples by microkjeldhal method as given in AOAC (1960) and expressed in percentage. Phosphorous content was estimated colorimetrically by Ammonium Vanado molybdate method as given in AOAC (1960).

Potassium content of fruit was determined colorimetrically by developing colour with cobalt nitrate solution (AOAC, 1960).

EXPERIMENTAL RESULTS

The effect of seed treatment with growth regulators and storing the treated seeds for different periods (0, 15 and 30 days) on germination, growth, flowering yield and quality of bhendi variety Pusa Sawani was studied and the results are presented as follows:

Effect on seed germination:-

The data on germination percentage of seeds in different treatments were statiscally analysed. The analysis of variance is given in Appendix-I.

The average values of percentage of germination as influenced by different treatments are given in Table-I, Fig-2.

The growth regulator treatments markedly increased the percentage of germination, GA 150 ppm recording the maximum germination percentage (94.00) followed by GA 100 and 50 ppm. In seeds treated with GA and stored for 15 or 30 days, the germination percentage was reduced. The difference between the effect of 15 and 30 days storage was not significant.

In the case of NAA treated seeds there were no significant differences among the effects of different concentrations (10, 20 and 40 ppm). There were also no significant differences among different treatments

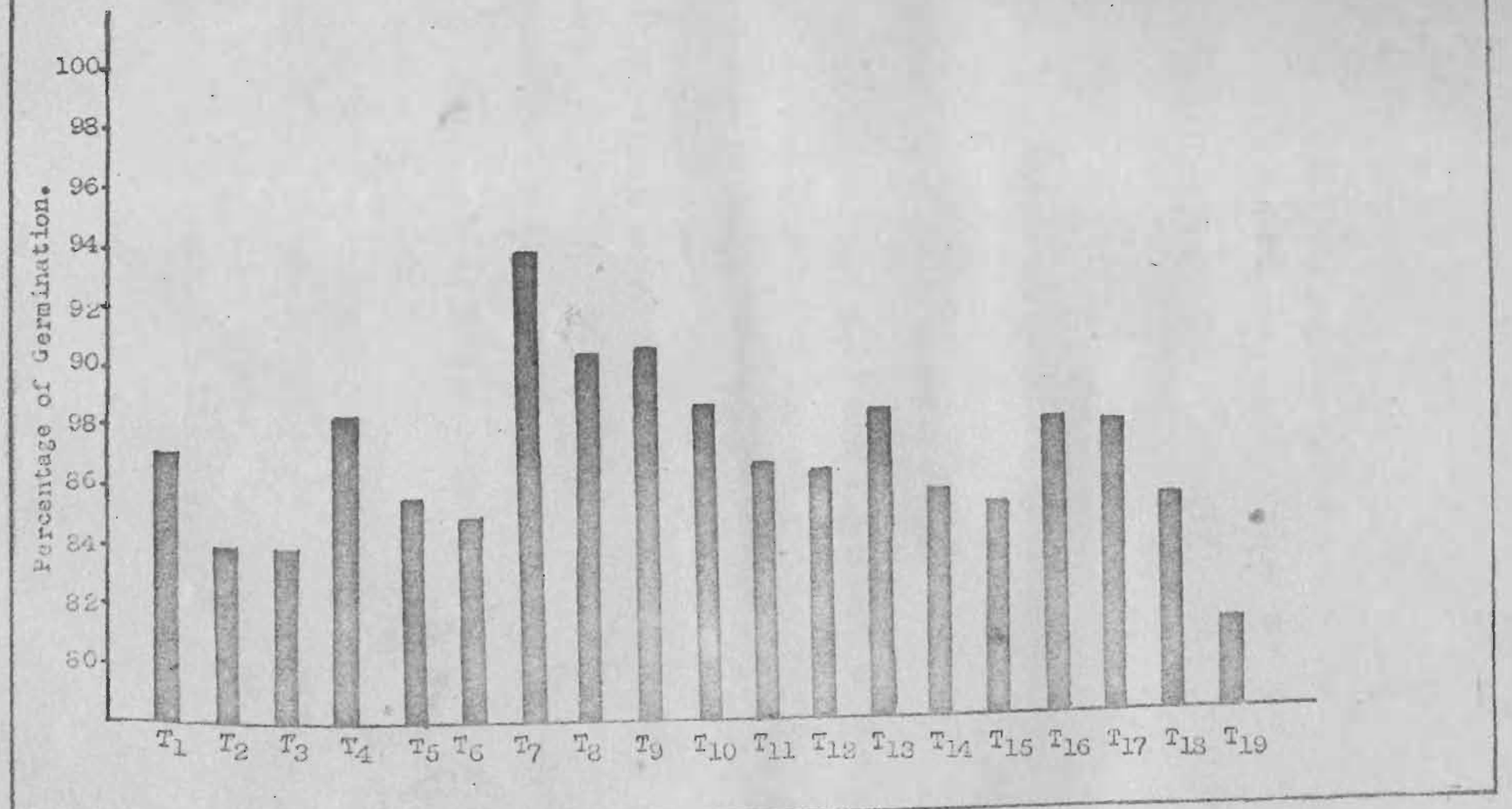
TABLE I

RESIDUAL EFFECT OF GROWTH REGULATORS ON GERMINATION OF BHENDI SEEDS

Treatments	Concentration (ppm)		Period of storage (days)	Germination Percentage
T1	GA	50	0	87.50
T2	GA	50	15	84.05
T3	GA	50	30	84.00
T4	GA	100	0	88.50
T5	GA	100	15	86.75
T6	GA	100	30	86.00
T7	GA	150	0	94.00
T8	GA	150	15	90.50
T9	GA	150	30	90.75
T10	NAA	10	0	88.75
T11	NAA	10	15	86.75
T12	NAA	10	30	86.50
T13	NAA	20	0	88.50
T14	NAA	20	15	85.50
T15	NAA	20	30	85.75
T16	NAA	40	0	88.25
T17	NAA	40	15	88.00
T18	NAA	40	30	85.50
T19	Control		0	81.00
	C.D.			3.08

Fig.(2) Germination percentage.

Scale= 1 cm. = 2%.



as well as storage periods.

In general, the germination percentage was higher in all the treatments as compared to control.

VEGETATIVE CHARACTERS:

Plant Height:-

Plant height was significantly influenced by seed treatment with growth regulators (Table-11, Fig.3). The analysis of variance is given in Appendix-11.

It is seen that there were significant differences among the GA treatments and increase in plant height was proportional to concentration. The maximum height of 97.66 cm was recorded with GA 150 ppm. In GA treated seeds when stored for 15 days, there was significant reduction in plant height, but there was no further reduction with 30 days storage.

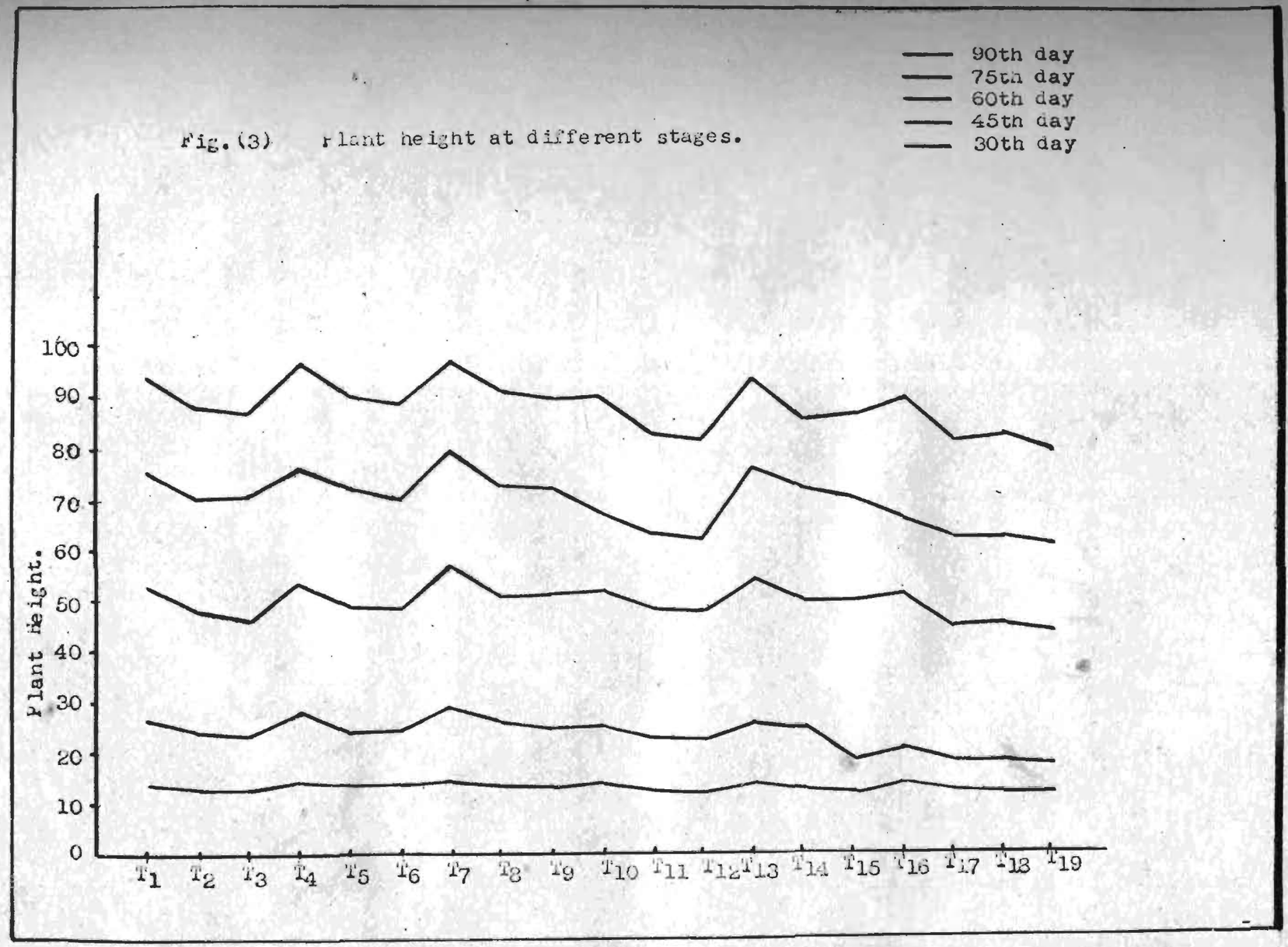
In the case of NAA, 20 ppm concentration recorded the maximum plant height (93.67 cm) and further increase or decrease in the concentration has reduced the plant height and the storage periods of 15 and 30 days are more or less equally effective. The control plants recorded the minimum height (79.29 cm).

Table 44

RESIDUAL EFFECT OF GROWTH REGULATOR ON PLANT HEIGHT IN BHENDI

Treatments	Concentration (ppm)		Period of storage (days)	Plant height in cm.
T1	GA	50	0	94.13
T2	GA	50	15	88.02
T3	GA	50	30	87.12
T4	GA	100	0	96.97
T5	GA	100	15	90.41
T6	GA	100	30	88.92
T7	GA	150	0	97.86
T8	GA	150	15	91.90
T9	GA	150	30	90.71
T10	NAA	10	0	90.14
T11	NAA	10	15	83.22
T12	NAA	10	30	82.11
T13	NAA	20	0	93.57
T14	NAA	20	15	86.64
T15	NAA	20	30	86.96
T16	NAA	40	0	89.22
T17	NAA	40	15	81.67
T18	NAA	40	30	82.09
T19	Control		0	79.27
	C.D.			5.53

Fig.(3) Plant height at different stages.



Number of leaves:-

The number of leaves per plant as affected by different seed treatments were recorded on 90th day after germination (Table-III and Fig.4) and the analysis of variance is given in Appendix-III.

Among the treatments, GA 150 ppm recorded significant increase in the number of leaves per plant followed by GA 100 ppm and NAA 20 ppm as compared with control.

There was no significant effect of storage of seeds for 15 or 30 days.

Number of Branches:-

Data on number of branches are presented in Table-III and analysis of variance is given in Appendix-IV.

The data revealed that there were significant differences among the treatments. The number of branches was highest under 100 ppm of GA (3.226) which is closely followed by the same treatment with 15 days storage period. These two treatments were significantly superior to all others and were also on par with each other.

Number of Nodes:-

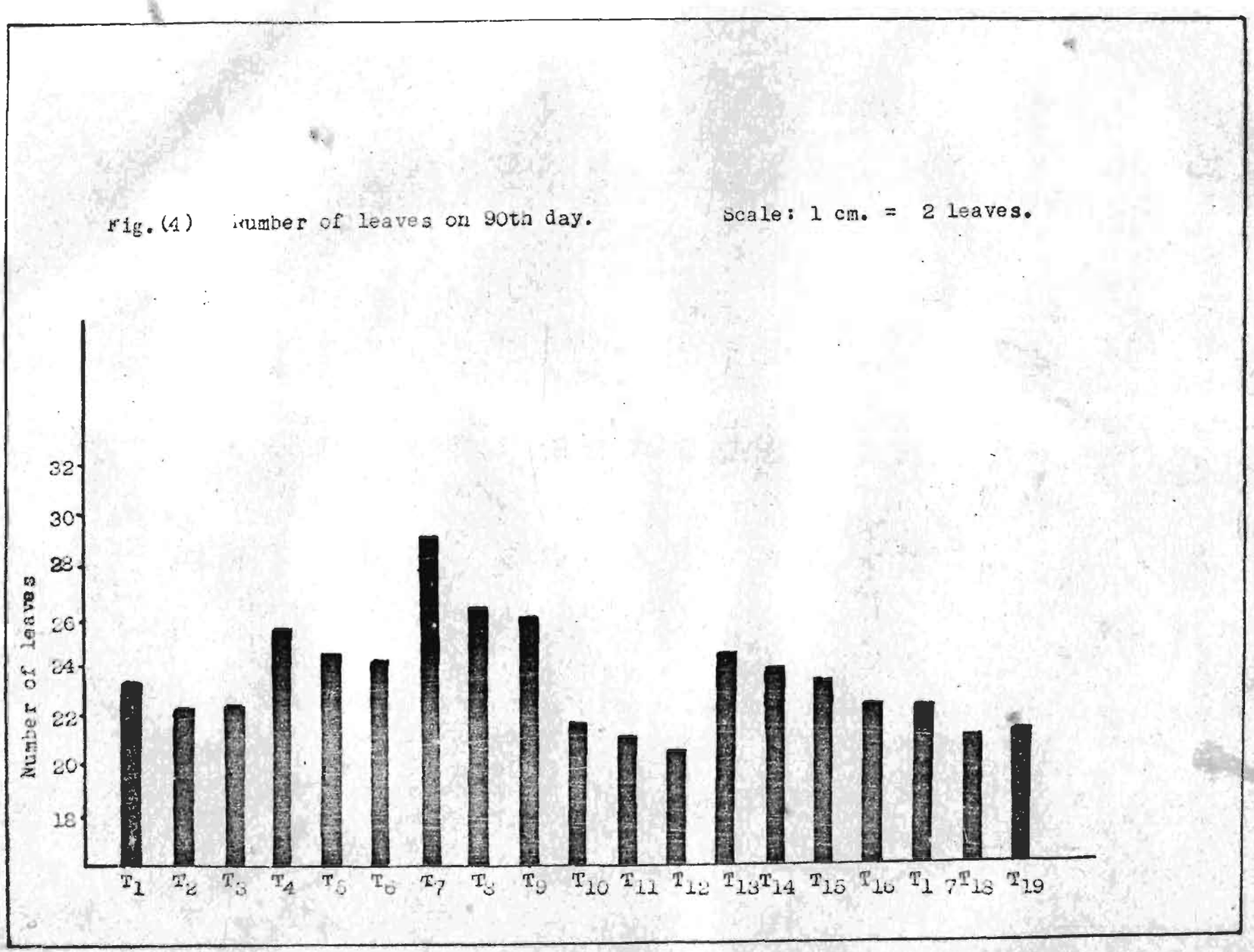
The data on the number of nodes on the main stem

T A B L E - III

NUMBER OF LEAVES AS AFFECTED BY RESIDUAL EFFECT OF PLANT GROWTH REGULATOR

Treatments	Concentration (ppm)		Period of storage (days)	Number of leaves
T1	GA	80	0	23.6
T2	GA	80	15	22.4
T3	GA	80	30	22.5
T4	GA	100	0	25.6
T5	GA	100	15	24.6
T6	GA	100	30	24.35
T7	GA	150	0	29.35
T8	GA	150	15	26.64
T9	GA	150	30	26.10
T10	NAA	10	0	21.85
T11	NAA	10	15	21.25
T12	NAA	10	30	20.65
T13	NAA	20	0	24.65
T14	NAA	20	15	24.00
T15	NAA	20	30	22.55
T16	NAA	40	0	22.50
T17	NAA	40	15	22.50
T18	NAA	40	30	21.35
T19	Control		0	21.50
	C.D.			3.92

Fig.(4) Number of leaves on 90th day. Scale: 1 cm. = 2 leaves.



T a b l e - IV

NUMBER OF BRANCHES AS INFLUENCED BY RESIDUAL EFFECT OF PLANT GROWTH REGULATORS

Treatments	Concentration (ppm)		Period of storage (days)	Number of branches Per plant
T1	GA	50	0	1.820
T2	GA	50	15	1.700
T3	GA	50	30	1.375
T4	GA	100	0	3.225
T5	GA	100	15	3.120
T6	GA	100	30	2.300
T7	GA	150	0	1.175
T8	GA	150	15	1.500
T9	GA	150	30	1.200
T10	NAA	10	0	2.200
T11	NAA	10	15	2.280
T12	NAA	10	30	2.125
T13	NAA	20	0	2.200
T14	NAA	20	15	1.875
T15	NAA	20	30	1.075
T16	NAA	40	0	1.800
T17	NAA	40	15	1.675
T18	NAA	40	30	1.575
T19	Control		0	1.325
	C.D.			0.170

are presented in Table-V and analysis of variance in Appendix-V.

It is seen that there were no significant differences among treatments. However the highest number of nodes per plant (13.5) was observed with GA 150 ppm and the lowest (8.50) with NAA 10 ppm.

Internodal length :-

The data on internodal length between 5th and 6th node is given in Table-VI and the analysis of variance in Appendix-VI.

Though there were no significant differences among treatment effects, the maximum value was recorded with GA 150 ppm and the minimum with NAA 10 ppm.

Diameter of the Stem:

The data on diameter of stem as influenced by seed treatments are presented in Table-VII and the analysis of variance in Appendix-VII.

It is evident from the table that there are no significant differences among the treatments. However maximum diameter of stem (1.84 cm) was recorded with GA 100 ppm followed by NAA 20 ppm.

T A B L E - V

NUMBER OF NODES ON THE MAIN STEM PER PLANT AS INFLUENCED BY RESIDUAL EFFECT OF GROWTH REGULATORS

Treatments	Concentration (ppm)		Period of storage (days)	Number of nodes
T1	GA	80	0	10.05
T2	GA	80	15	10.05
T3	GA	80	30	9.40
T4	GA	100	0	13.35
T5	GA	100	15	9.35
T6	GA	100	30	11.35
T7	GA	150	0	13.50
T8	GA	150	15	10.45
T9	GA	150	30	10.50
T10	NAA	10	0	8.80
T11	NAA	10	15	11.80
T12	NAA	10	30	10.75
T13	NAA	20	0	12.05
T14	NAA	20	15	11.50
T15	NAA	20	30	9.70
T16	NAA	40	0	10.80
T17	NAA	40	15	10.80
T18	NAA	40	30	10.20
T19	Control		0	10.20
				N.S.

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T A B L E VI

INTERNODAL LENGTH AS AFFECTED B[illegible] AL EFFECT OF PLANT GROWTH REG[illegible]

Treatments	Concentration (ppm)		Period of storage (days)	Internodal length in cm.
T1	GA	50	0	4.24
T2	GA	50	15	4.14
T3	GA	50	30	4.10
T4	GA	100	0	4.33
T5	GA	100	15	4.31
T6	GA	100	30	4.00
T7	GA	150	0	4.66
T8	GA	150	15	4.42
T9	GA	150	30	4.35
T10	NAA	10	0	4.42
T11	NAA	10	15	3.59
T12	NAA	10	30	3.67
T13	NAA	20	0	4.49
T14	NAA	20	15	4.15
T15	NAA	20	30	4.01
T16	NAA	40	0	4.46
T17	NAA	40	15	4.30
T18	NAA	40	30	3.98
T19	Control		0	4.21
				N.S.

TABLE - VII

DIAMETER OF THE STEM AS INFLUENCED BY RESIDUAL EFFECT OF PLANT GROWTH REGULATORS

Treatments	Concentration (ppm)		Period of storage (days)	Diameter of stem in cm.
T1	GA	50	0	1.765
T2	GA	50	15	1.620
T3	GA	50	30	1.580
T4	GA	100	0	1.840
T5	GA	100	15	1.570
T6	GA	100	30	1.515
T7	GA	150	0	1.595
T8	GA	150	15	1.510
T9	GA	150	30	1.390
T10	NAA	10	0	1.610
T11	NAA	10	15	1.550
T12	NAA	10	30	1.470
T13	NAA	20	0	1.760
T14	NAA	20	15	1.460
T15	NAA	20	30	1.650
T16	NAA	40	0	1.775
T17	NAA	40	15	1.565
T18	NAA	40	30	1.665
T19	Control		0	1.400
				N.S.

FLORAL CHARACTERS:

Number of days required for flowering:-

Data on the influence of seed treatment on flowering was recorded and presented in Table-VIII and Fig.5. Analysis of variance is given in Appendix-VIII.

Among GA 150 ppm treatment the number of days required for flowering was the minimum, followed by GA 100 ppm. Control plants required the highest number of days for flowering. Early flowering was observed in all treatments with 0 days period of storage.

FRUIT CHARACTERS

Fruit Size:-

Length of Pod:-

Data on fruit length as affected by GA and NAA at different concentrations and periods of storage are given in Table-IX. Analysis of variance is given in Appendix-IX.

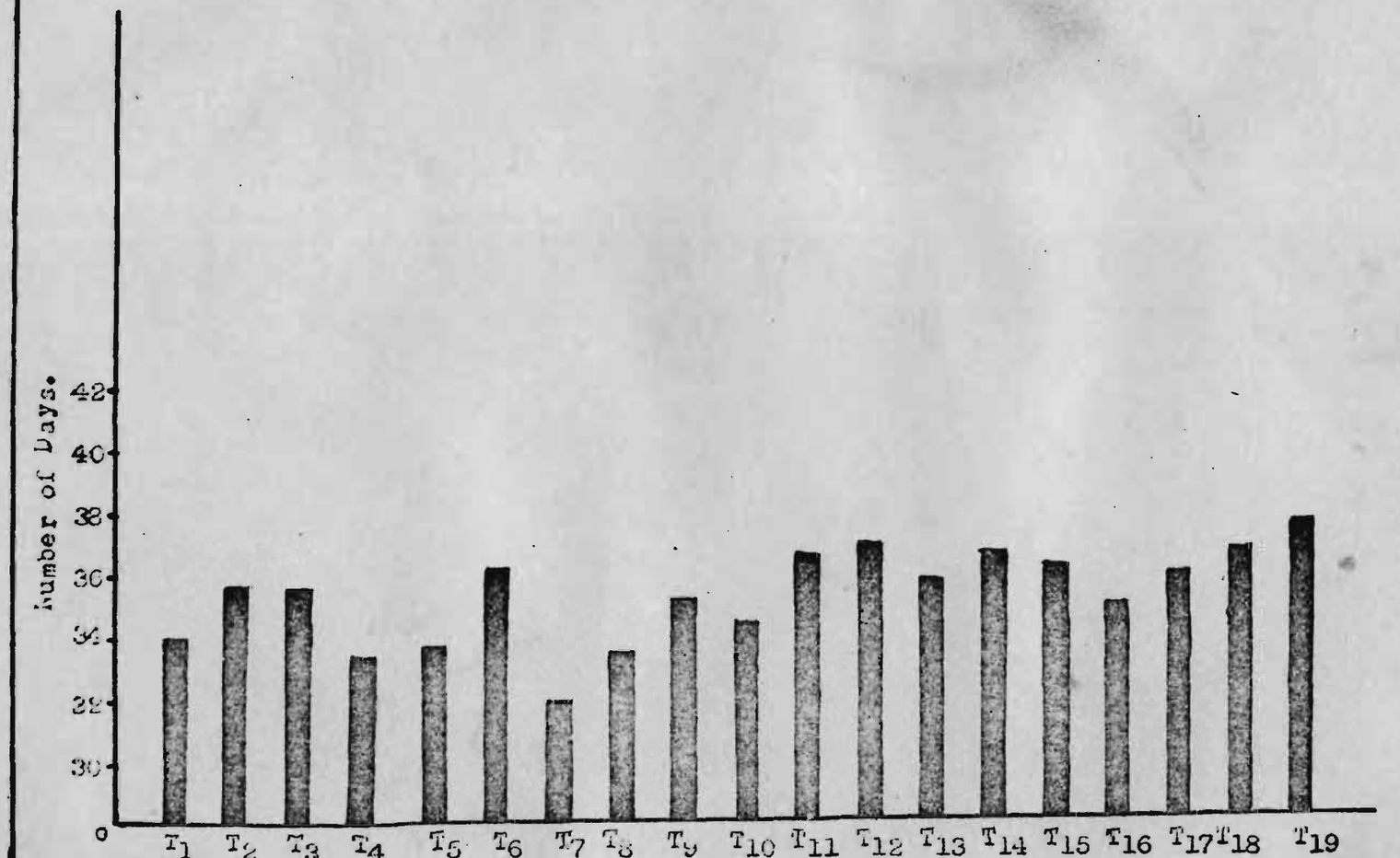
It is evident from the data that GA 100 ppm markedly increased the fruit length (16.44 cm) and proved to be significantly superior to the other treatments. Among NAA treatment, 10 ppm was more effective in this

T A B L E - VIII

RESIDUAL EFFECT OF PLANT GROWTH REGULATORS ON NUMBER OF DAYS REQUIRED FOR FLOWERING IN BHENDI

Treatments	Concentration (ppm)		Period of storage (days)	Number of days required for flowering
T1	GA	50	0	34.00
T2	GA	50	15	35.75
T3	GA	50	30	35.75
T4	GA	100	0	33.50
T5	GA	100	15	35.75
T6	GA	100	30	36.25
T7	GA	150	0	32.00
T8	GA	150	15	33.50
T9	GA	150	30	35.25
T10	NAA	10	0	34.50
T11	NAA	10	15	36.75
T12	NAA	10	30	37.00
T13	NAA	20	0	35.75
T14	NAA	20	15	36.75
T15	NAA	20	30	36.25
T16	NAA	40	0	35.00
T17	NAA	40	15	36.00
T18	NAA	40	30	36.75
T19	Control		0	37.50
	C.D.			2.02

Fig.(5) Number of days required for flowering Scale: 1 cm. = 2 days.



T A B L E - IX

LENGHT OF THE POD AS INFLUENCED BY RESIDUAL EFFECT OF GROWTH REGULATORS

Treatments	Concentration (ppm)		Period of storage (days)	Length of pod in cm.
T1	GA	50	0	14.530
T2	GA	50	15	14.108
T3	GA	50	30	12.820
T4	GA	100	0	16.440
T5	GA	100	15	15.135
T6	GA	100	30	13.885
T7	GA	150	0	14.540
T8	GA	150	15	13.090
T9	GA	150	30	13.455
T10	NAA	10	0	14.790
T11	NAA	10	15	13.550
T12	NAA	10	30	13.560
T13	NAA	20	0	14.720
T14	NAA	20	15	13.700
T15	NAA	20	30	14.140
T16	NAA	40	0	12.420
T17	NAA	40	15	12.400
T18	NAA	40	30	12.500
T19	Control		0	12.810
	C.D.			0.422

respect (14.77 cm), whereas NAA 40 ppm reduced the pod length to a minimum which was less than that under control.

Breadth of Pod:-

The data recorded on the breadth of fruit is presented in Table-X and the analysis of variance is given in Appendix-X.

NAA 10 ppm recorded the maximum breadth of fruit (2.295) which was significantly higher than that of any other NAA treatments. The minimum breadth of fruit was seen in control (1.87 cm).

Among GA treatments 100 ppm resulted in the maximum breadth (2.44).

YIELD:

Number of pods per plant:

The data on the number of fruits per plant as affected by GA and NAA treatments is given in Table-XI and the analysis of variance in Appendix-XI.

There were significant differences among the treatment effects of different concentrations of GA and NAA. But the differences among different periods of storage under any concentration were not significant.

Annexure

BREADTH OF THE POD AS INFLUENCED BY RESIDUAL EFFECT OF GROWTH REGULATORS

Treatments	Concentration (ppm)		Period of storage (days)	Breadth of pod in cm.
T1	GA	50	0	2.15
T2	GA	50	15	2.10
T3	GA	50	30	2.04
T4	GA	100	0	2.44
T5	GA	100	15	2.24
T6	GA	100	30	1.98
T7	GA	150	0	2.20
T8	GA	150	15	2.18
T9	GA	150	30	2.18
T10	NAA	10	0	2.29
T11	NAA	10	15	2.13
T12	NAA	10	30	2.13
T13	NAA	20	0	2.27
T14	NAA	20	15	2.22
T15	NAA	20	30	2.13
T16	NAA	40	0	1.91
T17	NAA	40	15	1.90
T18	NAA	40	30	1.88
T19	Control		0	1.86
	C.D.			0.12

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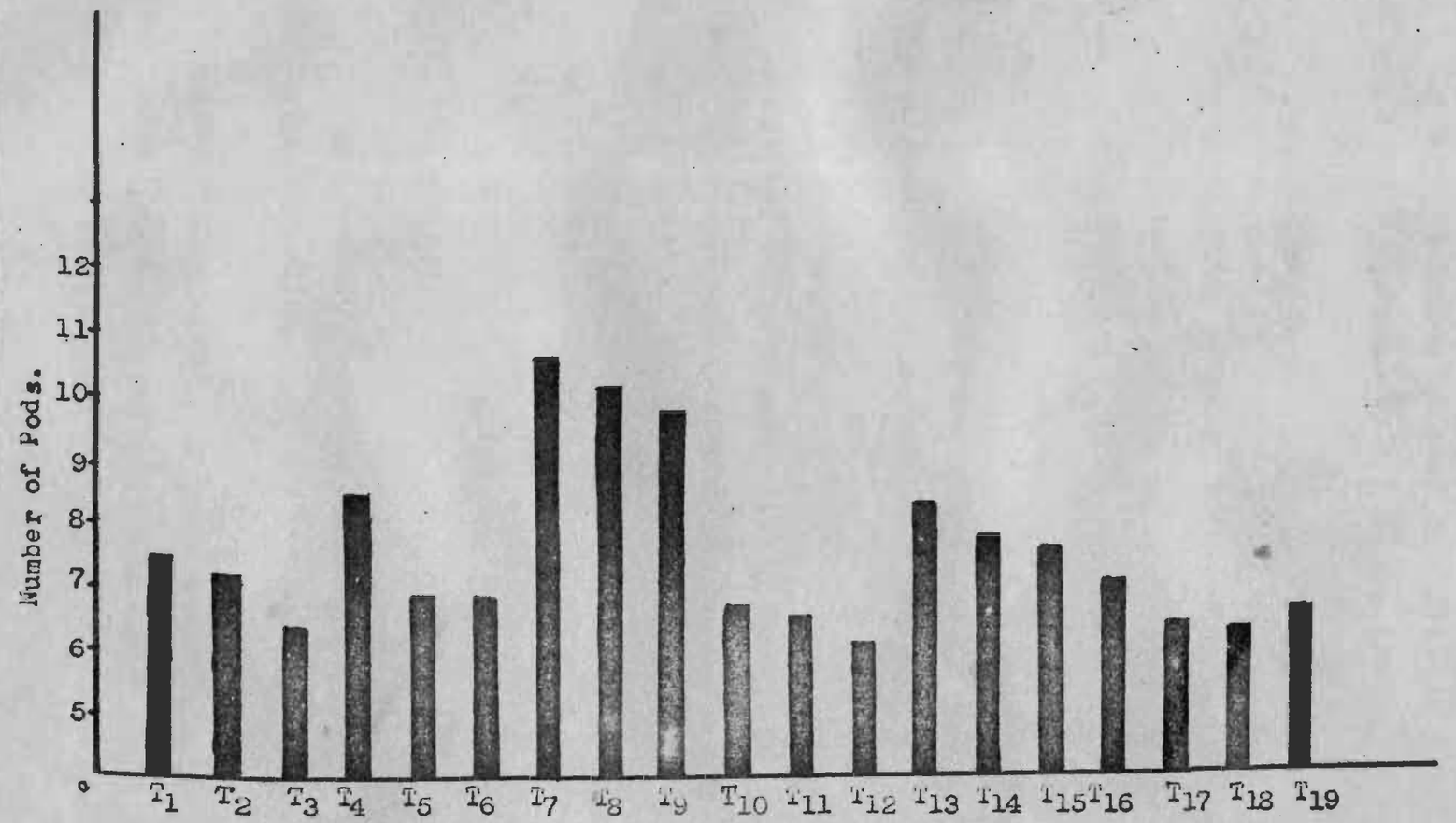
Table XI

NUMBER OF PODS PER PLANT [illegible] Y RESIDUAL EFFECT OF PLANT G[illegible]HS

Treatments	Concentration (ppm)		Period of storage (days)	Number of pods
T1	GA	80	0	7.67
T2	GA	80	15	7.25
T3	GA	80	30	6.40
T4	GA	100	0	8.50
T5	GA	100	15	6.92
T6	GA	100	30	6.92
T7	GA	150	0	10.65
T8	GA	150	15	10.15
T9	GA	150	30	9.87
T10	NAA	10	0	6.70
T11	NAA	1 0	15	6.50
T12	NAA	10	30	6.12
T13	NAA	20	0	8.35
T14	NAA	20	15	7.85
T15	NAA	20	30	7.60
T16	NAA	40	0	7.15
T17	NAA	40	15	6.45
T18	NAA	40	30	6.37
T19	Control		0	6.60
	C.D.			1.72

Fig.(6) Number of pods per plant. Scale: 1 cm. = 1 pod.



The maximum number of pods was obtained from GA 150 ppm (10.65) followed by NAA 20 ppm (8.35).

Number of pods per plot:

The total fruit yield in terms of number of fruits was recorded (Table-XII) and the analysis of variance is given in Appendix-XII.

The growth regulators had significant effect on total yield, and GA 150 ppm was significantly superior (2943.36) to other treatments including control in increasing the yield.

NAA 20 ppm was more effective in increasing the total yield (2530.80) compared to other NAA treatments and control.

The differences due to different storage periods were not significant in respect of both NAA and GA.

Weight of pods per plot:

Data are presented in Table-XIII and analysis of variance in Appendix-XIII.

GA 150 ppm was superior to all other treatments including control in increasing the yield (43.08 kg.) and it was followed by NAA 20 ppm (38.64 kg.).

T A B L E - XII

NUMBER OF PODS PER PLANT AND PER HECTARE INFLUENCED BY RESIDUAL EFFECT OF PLANT GROWTH REGULATORS

Treatments	Concentration (ppm)	Period of storage (days)	Number of pods per plot.
T1	GA 50	0	2169
T2	GA 50	15	2068
T3	GA 50	30	2006
T4	GA 100	0	2408
T5	GA 100	15	2290
T6	GA 100	30	2291
T7	GA 150	0	2043
T8	GA 150	15	2280
T9	GA 150	30	2245
T10	NAA 10	0	2271
T11	NAA 10	15	2163
T12	NAA 10	30	2120
T13	NAA 20	0	2530
T14	NAA 20	15	2475
T15	NAA 20	30	2415
T16	NAA 40	0	2068
T17	NAA 40	15	2025
T18	NAA 40	30	2000
T19	Control	0	2005
	C.D.		188.25

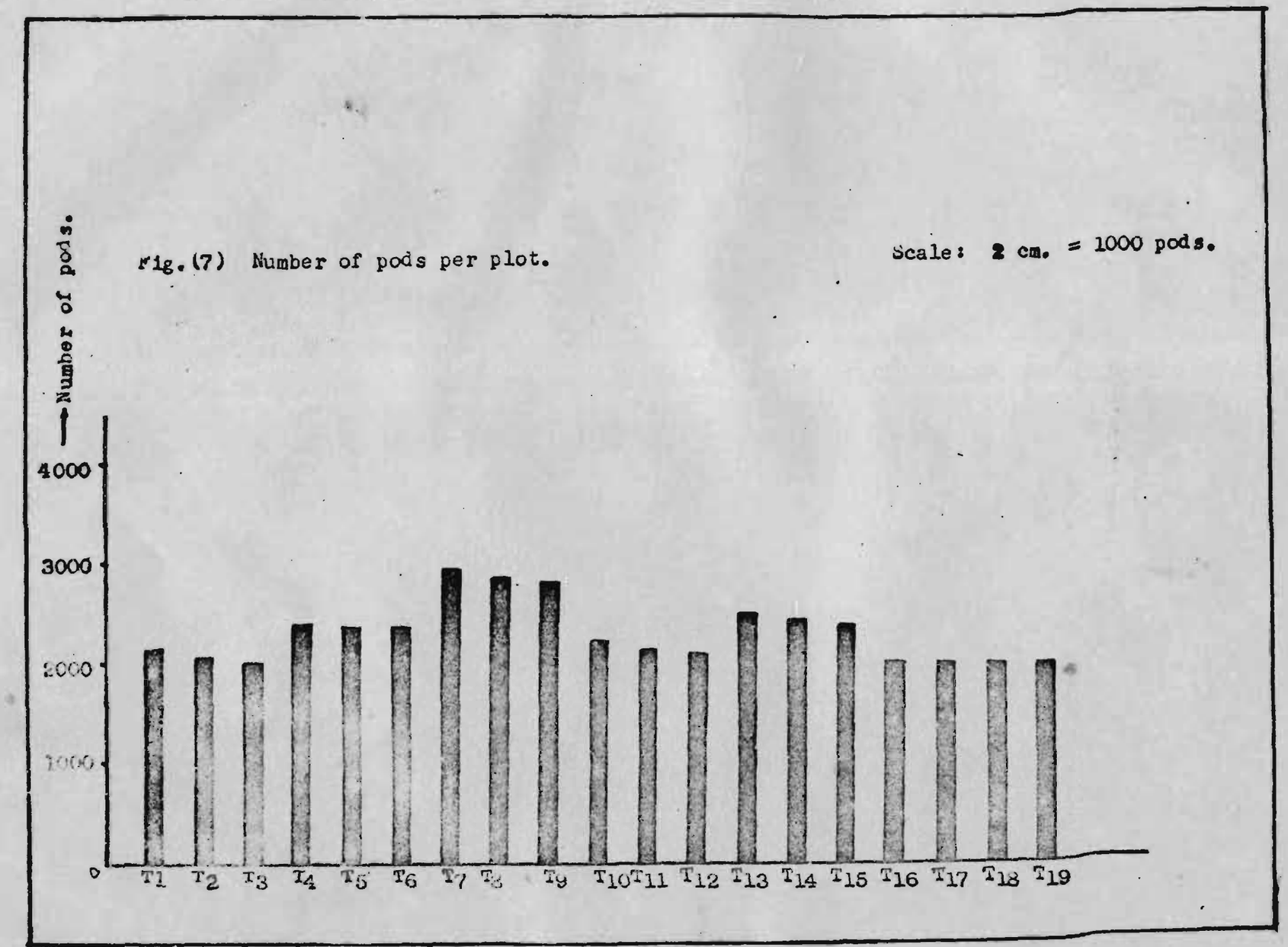


Fig.(7) Number of pods per plot.

Scale: 2 cm. = 1000 pods.

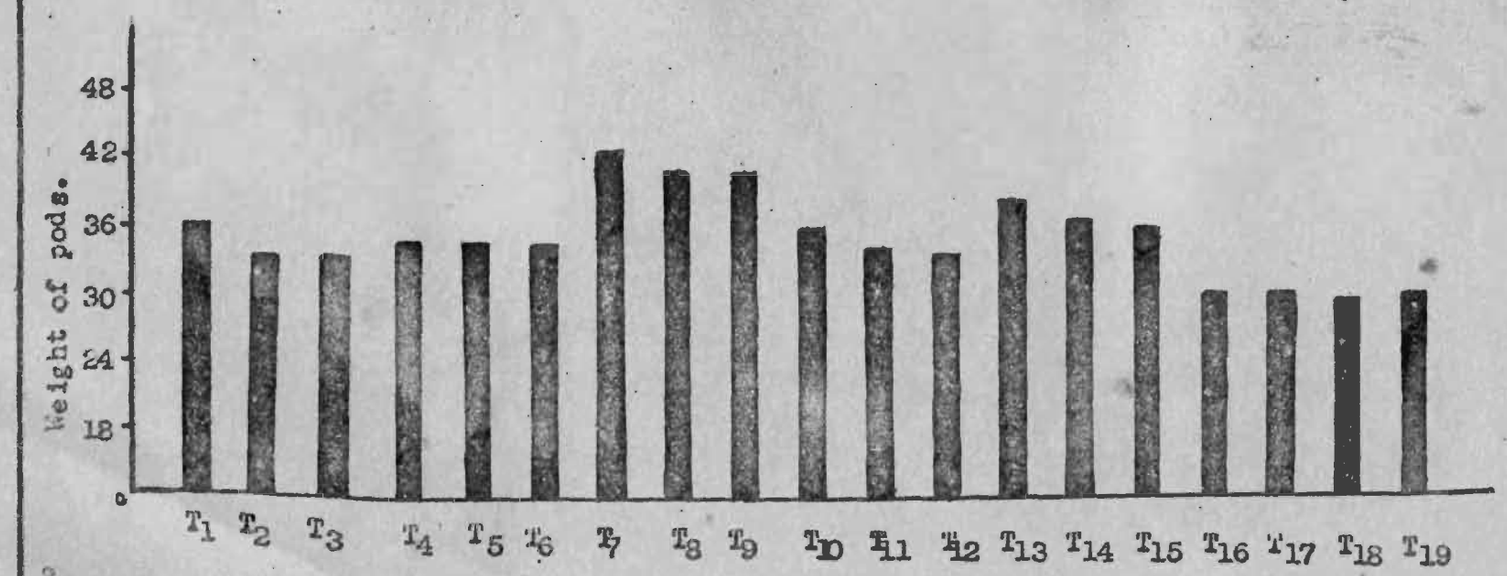
T A B L E - XIII

WEIGHT OF PODS PER PLOT AND PER HECTARE INFLUENCED BY RESI DUAL EFFECT PLANT GROWTH REGULATORS

Treatments	Concentration (ppm)	Period of storage (days)	Wt.of pod per plant in kg.	Wt.of pod per hectare in tons.
T1	GA 50	0	36.19	22.98
T2	GA 50	15	33.86	21.49
T3	GA 50	30	33.94	21.54
T4	GA 100	0	35.04	22.24
T5	GA 100	15	34.98	22.20
T6	GA 100	30	34.86	22.13
T7	GA 150	0	43.08	27.35
T8	GA 150	15	41.22	26.17
T9	GA 150	30	40.85	25.55
T10	NAA 10	0	36.00	22.855
T11	NAA 10	15	34.24	21.73
T12	NAA 10	30	34.64	21.99
T13	NAA 20	0	38.64	24.53
T14	NAA 20	15	36.78	23.35
T15	NAA 20	30	36.46	23.14
T16	NAA 40	0	30.48	19.35
T17	NAA 40	15	30.24	19.19
T18	NAA 40	30	29.94	19.00
T19	Control	0	30.25	19.20
	C.D.		2.564	

Fig.(8) Weight of pods per plot.

Scale: 1 cm.= 6 kg.



With the increase in concentration of GA the yield was also increased, but in respect of NAA the 20 ppm concentration was optimum while increase and decrease in concentration reduced the yield.

Number of seeds per pod:

The data noted on the seed content of pod are presented in Table-XIV. Analysis of variance is given in Appendix-XIV.

None of the treatments was effective in influencing the seed content of the pod.

FRUIT QUALITY:

Vitamin 'C' (Ascorbic acid) Content:

Vitamin 'C' content of fruits as affected by different treatments are presented in Table-XV.

It is seen that there was marked increase in Vitamin-'C' content in all treatments compared to control.

Maximum Vitamin 'C' content of pod was recorded with 20 ppm NAA (25.3 mg per 100 grams) followed by 40 ppm (25.00 mg).

DRY MATTER CONTENT OF FRUIT:

The data on dry matter content of pods as affected

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TABLE - XIV

NUMBER OF SEEDS PER POD AS INFLUENCED BY RESIDUAL EFFECT OF GROWTH REGULATION ON SEED TREATMENT

Treatments	Concentration (ppm)		Period of storage (days)	Number of seeds per pod
T1	GA	50	0	54.05
T2	GA	50	15	54.90
T3	GA	50	30	57.45
T4	GA	100	0	53.75
T5	GA	100	15	56.40
T6	GA	100	30	58.75
T7	GA	150	0	55.05
T8	GA	150	15	58.40
T9	GA	150	30	58.60
T10	NAA	10	0	54.00
T11	NAA	10	15	59.55
T12	NAA	10	30	59.70
T13	NAA	20	0	53.97
T14	NAA	20	15	53.70
T15	NAA	20	30	55.40
T16	NAA	40	0	54.35
T17	NAA	40	15	56.95
T18	NAA	40	30	58.30
T19	Control		0	65.61
				N.S.

TABLE-XI

VITAMIN 'C' CONTENT OF POD AS INFLUENCED BY RESIDUAL EFFECT OF PLANT GROWTH REGULATOR

Treatments	Concentration (ppm)		Period of storage (days)	Vitamin 'C' mg per 100gram
T1	GA	50	0	22.20
T2	GA	50	15	22.05
T3	GA	50	30	22.00
T4	GA	100	0	23.20
T5	GA	100	15	22.90
T6	GA	100	30	22.50
T7	GA	150	0	24.50
T8	GA	150	15	24.50
T9	GA	150	30	24.00
T10	NAA	10	0	24.20
T11	NAA	10	15	23.60
T12	NAA	10	30	23.60
T13	NAA	20	0	25.30
T14	NAA	20	15	24.70
T15	NAA	20	30	24.60
T16	NAA	40	0	25.00
T17	NAA	40	15	24.90
T18	NAA	40	30	24.30
T19	Control		0	20.20

by different treatments are presented in Table-XVI and the analysis of variance in Appendix-XVI.

The data revealed that none of the treatments was effective in influencing the dry matter content of fruit. However, maximum dry matter content was recorded with GA 150 ppm (9.872%).

N,P AND K CONTENTS OF FRUITS

Data on fruit composition of N, P and K are presented in Table-XVII. GA and NAA had no marked effect on the nitrogen content of fruit. NAA treatment had even slightly reduced it.

Maximum Nitrogen content was recorded with GA 100 ppm (2.879%) and minimum with 40 ppm NAA (2.051%).

Phosphorus content of the fruits was high in all the GA treatments and in 10 ppm NAA as compared to other treatments. Phosphorus content of pods obtained from control plots is slightly higher than in those from GA treatment at all concentrations, and NAA (10, 20 and 40 ppm) reduced the Phosphorus content.

GA treatments recorded more or less the same level of Potassium content as control, whereas NAA treatments resulted in increased Potassium content of fruits. The maximum Potassium content was obtained from NAA 20 ppm (3.531%).

TABLE XVI

RESIDUAL EFFECT OF PLANT GROWTH REGULATOR (SEED TREATMENT) DRY MATTER CONTENT OF THE FRUIT

Treatments	Concentration (ppm)	Period of storage (days)	Fresh weight (gms)	Dry Matter%
T1	GA 50	0	17.675	8.750
T2	GA 50	15	16.025	8.337
T3	GA 50	30	15.625	8.273
T4	GA 100	0	16.325	9.007
T5	GA 100	15	15.725	8.806
T6	GA 100	30	15.112	8.009
T7	GA 150	0	15.162	9.872
T8	GA 150	15	14.725	9.068
T9	GA 150	30	14.925	8.864
T10	NAA 10	0	15.600	8.071
T11	NAA 10	15	15.537	8.004
T12	NAA 10	30	15.150	7.827
T13	NAA 20	0	16.212	8.368
T14	NAA 20	15	15.125	7.810
T15	NAA 20	30	15.475	7.460
T16	NAA 40	0	14.175	8.368
T17	NAA 40	15	13.980	8.368
T18	NAA 40	30	13.762	8.365
T19	Control	0	14.662	8.226

N.S.

TABLE - XVII

EFFECT OF SEED TREATMENT ON NPK CONTENT OF FRUIT

Treatments	Concentration (ppm)	Period of storage (days)	N%	P%	K%
T1	GA	50	0	2.539	0.627	2.642
T2	GA	50	15	2.428	0.611	2.609
T3	GA	50	30	2.269	0.591	2.520
T4	GA	100	0	2.579	0.632	2.698
T5	GA	100	15	2.555	0.622	2.607
T6	GA	100	30	2.356	0.601	2.491
T7	GA	150	0	2.622	0.636	2.629
T8	GA	150	15	2.493	0.603	2.614
T9	GA	150	30	2.432	0.607	2.615
T10	NAA	10	0	3.348	0.632	3.631
T11	NAA	10	15	2.292	0.621	3.522
T12	NAA	10	30	2.255	0.626	3.221
T13	NAA	20	0	2.216	0.596	3.423
T14	NAA	20	15	2.203	0.593	3.412
T15	NAA	20	30	2.139	0.569	3.352
T16	NAA	40	0	2.051	0.545	3.413
T17	NAA	40	15	2.089	0.544	3.401
T18	NAA	40	30	2.140	0.541	3.334
T19	Control		0	2.599	0.642	2.659

DISCUSSION

Seed treatment with plant growth regulators and their residual effect after storage for different periods on growth, yield and quality of bhendi (variety-Pusa Sawani) were studied.

Growth regulator treatments markedly increased germination percentage. GA treatment recorded higher and quicker germination than NAA treatment. GA 150 ppm recorded maximum germination percentage (94.00). Though storage of treated seed reduced the percentage of germination, it was still significantly superior to control (81%). In the case of NAA, 10 ppm concentration recorded maximum germination percentage (88.75) and the reduction due to storage was negligible. Even the small reduction in the percentage of germination of seed treated with GA is however not considerable in view of the practical utility of pre-treating the seed before it is supplied to the cultivators.

Increase in the percentage of germination of treated seeds is ostensibly due to stimulatory effect of plant growth regulators on growth of embryo owing to better and quicker degradation and solubilization of starch and proteins in the endosperm and other storage tissues inside the seed (Paleg, 1960). The results relating to the effect on seed germination are in

confirmity with those reported by Sundar Raj and Muthu Krishnan (1966). Similar results with the use of GA and NAA on bhendi were reported by Srivastava (1968) and Pal et al.(1969). Maier et al. (1962), Srivastava (1971) and Singh et al.(1973). But the possibility of keeping the seed for some time after treatment without much loss of vaibility does not seem to have been explored previously.

Plant height was also influenced by growth regulators. Among GA treatments, 150 ppm concentration recorded the maximum height (97.66 cm) and among NAA treatments 80 ppm concentration recorded the heighest value (93.67 cm) as compared to control (79.27 cm). Though the reduction in plant height due to storage is significant, it is still significantly superior to control. Increase in plant height due to seed treatment in bhendi was reported by many workers (Nandpuri et al. 1969; Das et al. 1971; Srivastava 1960 and 1971) but the treated seeds were immediately sown by them. As such, the present study indicates the possibility of storing the treated seed without considerable loss in its residual effect on plant height.

Seed treatment with plant growth regulators has also resulted in an increase in total number of leaves

per plant and also the number of nods on the main stem of the plant. GA 150 ppm recorded the maximum values in both the characters, and among NAA treatments, 20 ppm recorded the maximum as compared to control. The reduction in their values due to storage is not significant.

GA 100 ppm has similarly recorded maximum number of branches per plant (3.225) among all treatments. In case of NAA treatments, 10 ppm concentration significantly increased the number of branches per plant (2.30). Seed storage slightly reduced the number of branches, but all the GA & NA treatments were significantly superior to control.

There were no significant differences among treatments in respect of internodal length. However GA 150 ppm recorded maximum internodal length (4.66 cm) followed by NAA 20 ppm (4.49 cm).

All the treatments withgrowth regulators increased the diameter of stem, the maximum being 1.84 cm with GA 100 ppm followed by NAA 40 ppm (1.78 cm) and NAA 20 ppm (1.76). Storing the seed after treatment shightly affected the diameter of stem but the treatments were superior to control.

Similar results relating to plant height, number of leaves, number of branches, number of nodes, internodal

length and diameter of stem were reported by Mandpuri et al (1969) with GA, Pal et al (1969) and Srivastava (1960) with GA and NAA in bhendi. Increases in these plant characters can be attributed to the well known effects of these chemicals on cell devision and cell elongation to a great extent and it is clear that the residual effects are retained even after storing the seeds for 15 or 30 days after treatment.

Flowering was early in all the treatments and the plants treated with GA 150 ppm required the lowest number of days for flowering (32), compared to control (37.5). Among NAA treatments 10 ppm concentration induced more earliness than other concentrations. Flowering was delayed in the case of stored seeds. Similar effects with GA was reported by Mandpuri et al (1969) and Das et al (1971) in bhendi and by Sadawarte and Gupta with GA and NAA in brinjal. This effect may be due to increased number of leaves as a result of which the photosynthetic effeciency of the plant is augmented thereby leading to early accumilation of endogenous constituents necessary for flowering.

The growth regulator treatments had a significant effect on total yield and GA 150 ppm was the most effective of all the treatments (43.08 kg) followed by

NAA 20 ppm (38.64). The differences due to different periods of storage were not significant. The increase in yield is obviously due to increase in number of pods per plant. These results are in confirmity with the findings of Srivastava and Sachan (1965), Srivastava and Singh (1968) Nandpuri et al (1969) and Pal et al (1970) with GA in bhendi and of Adulka et al (1965) with NAA in tomato. Increase in the yield of bhendi can be attributed to better growth, increased number of nodes, more branching and early flowering as are evident from the data on these aspects.

Fruit size was also significantly influenced by seed treatment with plant growth regulators. GA 100 ppm and NAA 10 and 20 ppm significantly increased the length and breadth of pod. Fruit size was reduced when the treated seeds were stored for 15 or 30 days but the treatments were superior to control. These results corroborate the findings of Srivastava and Singh (1968) with GA and NAA in bhendi and those of Gupta (1968) with GA and NAA in brinjal.

Seed content under all treatments was low as compared to control (66.61). GA 100 ppm and NAA 20 ppm recorded minimum number of seeds per pod (52.75 and 53.97 respectively). The seed number slighty increased

SUMMARY AND CONCLUSIONS

due to storage of seed for 15 or 30 days, but the values were lower than in control.

Marked increase in the ascorbic acid content was noticed under all treatments compared to control and the maximum was observed with NAA 20 ppm followed by NAA 40 ppm and GA 160 ppm. Thus there is improvement of fruit quality due to treatments with g rowth regulators since ascorbic acid content is considered to be one of the most important criteria of fruit quality. Storage of seeds, however had a decreasing effect on ascorbic acid content.

GA did not have much effect on Nitrogen content of fruits. However the maximum Nitrogen content was recorded with GA 100 ppm (2.679%) and NAA treatments slightly reduced the Nitrogen content as compared to control.

Phosphorus content was also not markedly influenced by treatments as compared to control. But some increases were there among treatments in regard to Potash content of fruit. The K content in GA treatments did not vary much while NAA treatments slightly influenced it, NAA 20 ppm recording maximum K (3.531%). Anyway these slight changes in N, P and K content of fruit may not indicate any tangible effect on nutritive value of fruit.

From the above discussion on various aspects of growth, yield and quality, it is clear that the effect of storage of seed for 15 or 30 days was either insignificant or not of considerable magnitude as to render the seed unfit for sowing. It is also evident that, not withstanding the slight reduction in the residual effect of growth regulators, the stored seed not only gave reasonably good percentage of germination but also produced plants with significantly superior growth resulting in higher yield and increased fruit quality, as compared to control. As such, the slight reduction in yield and yield attributes can be ignored in view of the obvious advantage of pretreating the seed before it is supplied to cultivators.

Studies were conducted to find out the effect of plant growth regulators applied through seed treatment and also their residual effect after storing the treated seed for 15 or 30 days, on growth, yield and quality in Okra, variety Pusa Sawani during summer season of 1976 at the College Farm of Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad. The results of these studies are summarised as follows:

1. Treatment of bhendi seed with plant growth regulators (GA and NAA) markedly increased the percentage of germination. Maximum percentage was obtained with GA 150 ppm. NAA treatment also markedly increased the percentage of germination.

In treated seeds stored for 15 or 30 days the percentage of germination slightly decreased.

2. Increased plant height and higher number of leaves were observed under GA and NAA treatments as compared to control. Storage of treated seed for 15 days reduced plant height and number of leaves but further increase in the period of storage to 30 days did not have any additional effect.

3. GA 100 ppm treatment resulted in maximum number of branches whereas both 150 and 50 ppm of GA significantly reduced the number of branches. NAA 10 and 20 ppm increased number of branches over control.

There is a reduction in the number of branches with the increase in period of storage.

4. Seed treatment of bhendi with GA 150 ppm induced early flowering by 5 days and NAA 10 ppm by 3 days.

Delay in flowering was observed with the increase in the period of storage of treated seed in general in all treatments.

5. GA 100 ppm markedly increased the length and breadth of pod over control. NAA 10 and 20 ppm also increased the breadth fruit size.

6. All treatments increased the yield of bhendi as compared to control. GA 150 ppm was the most effective and NAA 20 ppm was the most beneficial among NAA treatments.

The differences due to different storage periods were not significant.

7. All treatments increased the ascorbic acid

content as compared to control and the maximum values was obtained with NAA 80 ppm, followed by NAA 40 ppm and GA 150 ppm.

8. GA and NAA treatments did not have much effect on Nitrogen content of fruit. Phosphorus content of fruit was higher under GA treatments as compared to NAA treatments.

NAA recorded increased Potassium content where as GA had no effect.

The plant growth regulators GA and NAA at 150 ppm and 20 ppm, respectively, applied to seed as a pre-sowing treatment, have proved to be effective in increasing the plant growth, yield and quality of fruits in Okra. Further there was no marked deleterious effect of storing the treated seed for one month. This finding opens up the possibility of treating the seed before supplying to cultivators. As the farmers lack advant technical knowledge and hence cannot confidently handle these chemicals to get the desired benefit, pre-treatment of seed can be done by technical staff before distributing it to the farmers. So, this method can be adopted on a large scale after obtaining confirmatory results by further follow-up studies in different kinds of vegetables.

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APPENDIX

APPENDIX - I

Analysis of Variance for percentage of germination

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	3	63.69	21.21	
Treatments	18	609.96	33.886	7.322 **
Error	54	253.37	4.629	
Total	75			

APPENDIX - II

Analysis of variance for plant height

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	3	9.33	3.11	
Treatments	18	1848.36	102.69	6.77 **
Error	54	819.15	15.17	
Total	75			

APPENDIX - III

Analysis of variance for number of leaves

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	3	53.29	17.76	
Treatment	18	349.31	19.41	2.55 **
Error	54	411.73	7.62	
Total	75			

** Significant at both 5% and 1% levels.

APPENDIX - IV

Analysis of variance for number of branches

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	2	1.05	0.352	
Treatment	18	27.60	1.533	10.22 **
Error	54	7.903	0.15	
Total	75			

APPENDIX - V

Analysis of variance for number of nodes

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	2	33.25	11.08	
Treatment	18	118.88	6.60	1.21 N.S.
Error	54	296.84	5.50	
Total	75			

APPENDIX - VI

Analysis of variance for internodal length

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	2	2.625	0.875	
Treatment	18	7.14	0.397	1.105 N.S.
Error	54	19.375	0.359	
Total	75			

** Significant at both 5% and 1% levels.
N.S. Not found to be significant.

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APPENDIX - VII

Analysis of variance for Diameter of stem

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	3	0.401	0.133	
Treatment	18	1.082	0.60	1.23 NS
Error	54	2.66	0.0495	
Total	75			

APPENDIX - VIII

Analysis of variance for number of days required for flowering

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	3	15.934	5.311	
Treatment	18	143.07	7.948	3.942 **
Error	54	108.878	2.0162	
Total	75			

APPENDIX - IX

Analysis of variance for length of pod

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	3	0.176	0.0587	
Treatment	18	80.45	4.47	5.39 **
Error	54	44.764	0.829	
Total	75			

NS: Not found to be significant.
** Significant at both 5% and 1% levels.

APPENDIX - X

Analysis of variance for breadth of pod

Source of variance	D.F.	S.S.	M.S.S.	F. Value
Replication	3	11.645	3.886	
Treatment	18	1.851	0.1028	2.315 **
Error	54	2.399	0.444	
Total	75			

APPENDIX - XI

Analysis of variance for number of pods per plant

Source of variance	D.F.	S.S.	M.S.S.	F. Value
Replication	3	1.51	0.50	
Treatment	18	132.66	7.36	4.91 **
Error	54	80.79	1.50	
Total	75			

APPENDIX - XII

Analysis of variance for number of pods per plot

Source of variance	D.F.	S.S.	M.S.S.	F. Value
Replication	3	45431.30	15143.77	
Treatment	18	6727630.87	373761.72	21.33 **
Error	54	946425.23		
Total	75			

** Significant at both 5% and 1% levels.

APPENDIX - XIII

Analysis of variance for weight of pods per plot

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	3	16.71	5.57	
Treatment	18	1036.79	57.60	17.67 **
Error	54	176.27	3.26	
Total	75			

APPENDIX - XIV

Analysis of variance for number of seeds per pod

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	3	556.34	185.446	
Treatment	18	996.63	55.368	1.124 NS
Error	54	2658.83	49.237	
Total	75			

APPENDIX - XV

Analysis of variance for percentage of dry matter content of pod

Source of variance	D.F.	S.S.	M.S.S.	F.Value
Replication	3	3.74	1.246	
Treatment	18	21.87	1.228	1.506 NS
Error	54	43.99	0.815	
Total	75			

** Significant at both 5% and 1% levels.
NS:Not found to be significant.