Bangladesh J. Sci. Ind. Res. **42**(1), 59-66, 2007

Effect of Pre Harvest Application of Some Growth Regulators on the Yield and Quality Characteristics of Grape (*Vitis vinifera* L.)

S. Begum, M. Ibrahim, A. Samad, M.R. Khan, S.Khaleda, A.K.M.S.Alam and A.N. Chowdhury

BCSIR Laboratories, Binodpur Bazar, Rajshahi-6206, Bangladesh.

Abstract

Present study was undertaken to investigate the relative efficacy of four growth regulators, *viz.*, α-naphthalene acetic acid (NAA), indole-3-acetic acid (IAA), gibberellic acid (GA) and 2,4-Dichlorophenoxy acetic acid (2,4-D) at various concentrations (ppm) on the yield and some other quality characteristics of grape (Zakkao cultivar) at the experimental grape research vine of BCSIR Laboratories, Rajshahi during the period January, 2003 to July, 2004. Yield was found to be increased (33.11 %) by spraying with 05 ppm of 2,4-D as compared to control and other growth regulator treatments. Fruits of treated plants showed increased total soluble solids (20.28 %) and vitamin (23.18 %) than that of untreated one. The titrable acidity (T. A) of fruits (33.01 %) of the treated plants was reduced significantly as compared to control.

Introduction

Grape is one of the earliest fruits grown by man (Salunkhe and Kadam, 1995). It is mainly cultivated in Italy, France, Chile, China, USA, Turkey, India, Pakistan etc. It is the most widely cultivated fruit and was carried from region to region by civilized man in all the temperate climates and has been more recently in tropical and subtropical climates. Among the fruits, grape occupies first position in the world in respect of area and production. The total area of cultivation is 61,300ha and the total world production (in 2003) was 46,97,000MT (FAO, 2003).

There are more than 1000 grape cultivars known all over the world but only a limited number are standard. In Bangladesh, sporadic attempts were taken earlier to grow grapes but none of these efforts were reported to be a success. Recently, Zakkao cultivar of grape was found to be produced successfully in our country (Nuruzzaman, 1994). Grape is the most delicious, refreshing and nourishing fruit of the world. But sweetness of the grape produced in our country is not up to standard. In the tropical climate high temperature, rainfall and humidity cause diseases

and inhibit luxuriant growth of grape (Janick and Moore, 1977). Rainfall spoils the crop production through dilution or washes away the stigmatic fluid, causes poor pollination and rotting of fruits. On the other hand, high temperature prevailing during maturity reduces the berry size and sugar content probably due to increased respiration (Pandey and Pandey, 1996). Plastic covering would appear to be advantageous in improving the quality of grape through protection from rain, light, sunshine intensity (Avenant and Loubser, 1993). Application of growth regulators is also reported to increase the yield and quality of grape. Among the plant hormones applied in grapes, GA being growth promoting hormone commands a special place and is being used for different purposes such as to loosen the bunch, increase the berry size and improve the growth, yield and quality of fruits (Jindal, 1985). The present study was, therefore, undertaken to investigate the effect of four growth regulators on the yield and quality characteristics of grape under the climatic condition of Rajshahi.

Materials and Methods

The field experiment was conducted at the experimental grape research vine and chemical analyses of fruits were carried out at the Laboratory. The experiment was carried out from January 2003 to July 2004. Four years old 40 grape plants of Zakkao cultivar were selected, three plants serving a block. The experimental plants were designed and marked properly. The plants were sprayed with 25(T_1), 50(T_2), 75(T_3) ppm of gibberellic acid (GA); 20(T_4), 40(T_5), 60(T_6)ppm of indole-3-acetic acid (IAA); 20(T_7), 40(T_8), 60(T_9)ppm of α-naphthalene acetic acid (NAA) and 05(T_{10}), 10(T_{11}) 15(T_{12})ppm of 2, 4-diclorophenoxy acetic acid (2, 4-D). The control plant (T_0) was sprayed with water in identical condition. Every time spray was done on sunny days. The experimental plants were first sprayed after berry set, when the fruits became pea size. The 1st spray was applied on 15 April, 2004. The 2nd, 3rd, 4th and 5th were done on 30 April, 15 May, 30 May and 15 June, 2004, respectively. The spray was done at pit hardening stage between 12.00 noon to 3.00 pm. Manure and fertilizers were applied as per standard doses and method (Fertilizer Recomamendation Guide, 1997). Cultural practices were done as and when necessary.

Fruits from the treated and control plants were collected at an interval of 15 days from each spray and were analyzed for different quality characters. Whole weight of the fruit was taken by weighing method. The quality characters analyzed were total soluble solids, acidity, and vitamin C. Total soluble solids was determined by refractometric method (Gofur *et. al.,* 1998). Acidity was determined by the acid-base titrimetric method (Ranganna, 1986) using standard sodium hydroxide solution. Vitamin C content was estimated by the titrimetric method (Mahadevan and Sridhar, 1982) using 2, 6

dichlorophenol indophenol indicator. Organoleptic tests (test for taste) were conducted for the treated and control fruits by a test panel consisting of five member of scientists to determine the quality and acceptability of the fruits and were classified as follows on the basis of grading made by test panel: excellent = 80 % or above, good = 70 - 79 % and fair = less than 70 % considering appearance, colour, flavour, taste and texture. The recorded data were statistically analysed and the means of different parameters were compared by least significant difference (LSD) test.

Results and Discussion

Analysis of variance was done to test the significant deviations of different sources of variations (Table I) for all the characters. The analysis showed that the item treatment (T) and harvest (H) were highly significant against their experimental error for all the characters. It is suggested that a real effect existed among the treatments and there was also a real difference of different harvest for the characters studied. The interaction item treatment × harvest (T × H) was also significant for all the characters, which indicated that the treatments interacted with harvest significantly.

Fruit weight of grape from the control and hormone treated plants at 15 days interval during developmental stages were recorded (Table II). It was revealed from the data that the yield of grape fruits were significantly influenced by the treatment of growth regulating chemicals (Table I). Among the growth regulator treatments, yield was found to be increased significantly by spraying with 50ppm of GA and 15ppm of 2, 4-D as compared to control and other treatments. However, the highest increase in fruit weight (3.92gm / fruit) was recorded in case of 50ppm GA. It is obvious from the data that the increase in fruit weight was recorded significantly more in all the GA treatments over

Table I. Analysis of variance for yield and quality characteristics of grape (only mean square values were shown)

Item	df	Fruit yield of grape(gm)	Total soluble solids (%)	Acidity content (%)	Vitamin C content(mg/100g)
Treatment(T)	12	0.26***	8.17***	0.72***	109.29***
Harvest (H)	4	34.41***	1278.64***	41.71***	22295.54***
T × H	48	0.05***	1.72***	0.16***	69.04***
Replication	2	0.13***	14.69***	0.04***	23.02***
Error	128	0.0008	0.13	0.00005	0.29

*** Significant at 0.1% level.

Table II. Fruit yield of control and hormone treated grape at 15 days interval after each spray.

Treatments		Weight / fruit of grape (gm) at different harvesting periods				
		1st	2nd	3rd	4th	5th
Control	T_0	1.51	1.72	2.35	2.65	2.96
	T_1	1.56	2.03	2.85	3.38	3.88
GA	T_2	1.84	2.20	2.99	3.76	3.92
	T_3	1.68	1.97	3.04	3.57	3.69
	T_4	1.50	1.86	2.47	3.59	3.64
IAA	T_5	1.50	1.91	2.84	3.42	3.75
	T_6	1.56	1.79	2.70	3.52	3.63
	T_7	1.54	1.77	2.42	3.44	3.41
NAA	T_8	1.65	1.83	2.59	3.35	3.87
	T_9	1.59	1.89	3.14	3.34	3.46
	T_{10}	1.69	1.79	2.76	3.74	3.94
2, 4-D	T_{11}	1.70	1.78	2.66	3.51	3.74
	T_{12}	1.64	1.87	2.90	3.81	3.90
LSD at	5 %	0.119	0.058	0.075	0.028	0.106
	1 %	0.161	0.078	0.102	0.038	0.144

the control. The increase in fruit weight (3.41gm) was negligible with 20ppm NAA whereas the 40ppm NAA produced significantly higher fruit weight. The increase in fruit weight with various concentrations of GA and 2,4-D treatment differ significantly from each other but did not differ significantly in IAA and NAA. Krishnamurthi (Krishnamurthi *et. al.*, 1959) found that the treatments of GA had increased the berry weight in pusa seedless grapes which was in close agreement with the present work. Singh *et al.* (1986) also reported similar findings in pusa seedless grape.

The results are quite evident from the data (Table III) that the percentage of total soluble solids in plant hormone treated fruits increased significantly. The higher concentration of 2, 4-D produced significantly higher total soluble solids over the control followed by 10ppm of 2, 4-D and 50ppm of GA. Singh *et al.* (1986) reported that total soluble solids of pusa seedless cultivar of grape was increased with the application of thiourea. Similar results were also reported by Manivel and Sundararaj (1968) in grape cultivar of anab-e-shahi and pachadraksha.

There was overall decrease in acidity content. However, this decrease was significantly higher in all the treatments as compared to control. It is evident from the data (Table IV) that NAA 20 and 60ppm proved to be the most effective treatment in reducing the acidity content in treated fruits over the control. These results are in conformity with those of Manivel and Sundararaj (1968) Singh *et al*. (1986) also observed similar results in pusa seedless cultivar of grape.

Table IV. Acidity content of control and hormone treated grape at 15 days interval after each spray

Treatments		Acidity content of grape (% as citric acid) at different harvesting periods				
		1st	2nd	3rd	4th	5th
Control	T_0	3.22	2.98	2.32	1.85	0.93
GA	T_1	3.15	2.19	1.37	1.26	0.61
	T_2	3.18	2.00	1.24	0.60	0.61
	T_3	3.25	2.28	1.05	0.63	0.72
IAA	T_4	3.19	2.30	1.08	0.66	0.55
	T_5	3.08	2.00	1.10	1.05	0.81
	T_6	3.22	2.11	1.33	1.19	0.52
NAA	T_7	3.21	2.78	1.43	1.19	0.50
	T_8	3.15	2.53	1.19	0.88	0.36
	T_9	3.17	2.73	1.55	1.13	0.50
2, 4-D	T_{10}	3.12	2.59	1.36	0.66	0.72
	T_{11}	3.20	2.84	1.54	1.71	0.83
	T_{12}	3.16	2.67	1.86	0.99	0.75
LSD at	5 %	0.027	0.075	0.034	0.034	0.044
	1 %	0.036	0.101	0.045	0.045	0.061

The increase of vitamin C content (Table V) in all the hormone treated fruits was significantly more over the control. However, the highest increase in vitamin C content was recorded in case of 40ppm NAA followed by 20ppm and 60ppm NAA, 15ppm 2, 4-D and 40ppm IAA treatments. These results confirm earlier findings of Robbani *et al.* (1996) in grape cultivar of Zakkao. The overall quality of the fruit from control and hormone treated plants were compared by a panel of scientists on the basis of appearance, colour, flavour, taste and texture. It can be concluded from the findings of the panel that the fruits of the treated plants are quite superior over the control (Table VI). Similar

Table V. Vitamin C content of control and hormone treated grape at 15 days interval after each spray

Treatments		Vitamin C content of grape (mg/100g) at different harvesting periods				
		1st	2nd	3rd	4th	5th
Control	T_0	52.06	36.06	24.23	4.64	2.53
	T_1	58.23	44.54	32.00	8.67	2.58
GA	T_2	53.62	57.36	34.26	7.40	2.60
	T_3	56.70	36.46	29.83	5.52	2.72
	T_4	52.91	45.58	35.25	6.44	2.86
IAA	T_5	62.04	57.36	37.57	4.64	3.26
	T_6	63.02	53.81	31.45	4.88	3.20
	T_7	55.76	35.63	26.85	5.80	3.36
NAA	T_8	61.80	34.84	24.61	5.31	3.73
	T_9	63.12	38.24	25.79	5.48	3.72
	T_{10}	62.08	37.65	28.32	5.27	2.67
2, 4-D	T_{11}	57.50	52.26	33.43	4.71	3.44
	T_{12}	56.85	35.58	37.85	5.65	3.36
LSD at	5 %	0.237	0.336	0.336	0.750	0.034
	1 %	0.321	0.445	0.456	1.020	0.046

Table VI. The grading of ripe grape fruit collected from control and hormone treated plants as judged by a panel of scientists based on overall qualities

Sample	*Treat ments	Marking by individual judges.					Total marks	Mean	Rating
		01	02	03	04	05			
Appearance	T	85	80	81	78	77	401	80.20	Excellent
	C	72	70	65	71	80	358	71.60	Good
Colour	T	80	78	85	81	87	411	82.20	Excellent
	C	74	70	78	80	75	377	75.40	Good
Flavour	T	83	81	80	77	84	405	81.00	Excellent
	C	68	72	75	59	60	334	66.80	Fair
Taste	T	81	86	82	80	78	407	81.40	Excellent
	C	60	67	70	72	68	337	67.40	Fair
Texture	T	88	80	79	83	86	416	83.20	Excellent
	C	56	73	68	70	73	340	68.00	Fair

*T = Treated, *C = Control

results were reported by Singh *et al.*[13] in grape cv. pusa seedless treated with thiourea.

References

Avenant. J. H. and Loubser, J. H. (1993) The potential of overhead plastic covering for advanced ripening of table grapes. Deciduous Fruit Grower. **43**(5) :173-176.

FAO. (2003) Production Year Book. Rome, Italy Vol. 57. p181.

Fertilizer Recommendation Guide- (1997) Bangldesh Agricultural Research Council, Farm gate, New airport road, Dhaka-1205. pp. 92.

Gofur, M.A., Shafique, M.Z. Helali, M.O.H. Ibrahim, M. and Rahman, M.M. (1998) Effect of application of plant hormone on the control of fruit drop, yield and quality characteristics of mango (*Mangifera indica* L.). *Bangladesh J. Sci. Ind. Res.* 33(4): 493-498.

Janick, J. and Moore, J. N. (1977) Advances in Fruit Breeding, Purdue University Press, West Lafayetto, Indiana (USA). pp.130-153.

Jindal, P.C. (1985) Grape. In: T.K. Bose and S.K. Mittra (Eds). Fruits of India Tropical and Subtropical. Naya Prokash, Calcutta 6, India pp. 258-259.

Krishnamurthi S., Randhawa, G. S. and Singh, J.P. (1959) Effect of Gibberellic acid on fruit set, size and quality in the pusa seedless variety of grape (*Vitis vinifera* L). *Ind. J. Hort.* **16**(1): 1- 4.

Mahadevan, A. and Sridhar, R. (1982). Methods in Physiological Plant Pathology, 2nd Ed. Sivakami Publication. Madras. India p.171.

Manivel, L. and Sundararaj, J.S. (1968) A note on the effect of gibberellic acid on anab-e-shahi and pachadraksha varieties of grape (*Vitis vinifera* L.) *South Indian Hort*. **16**: 65-66.

Nuruzzaman M. (1994). Grape Production Technology(In Bengali), Deraz Printers, Arambag, Dhaka, pp. 9-42.

Pandey, R. and Pandey, S. (1996) The grape in India. Indian Council of Agricultural Research. New Delhi pp. 28-30.

Ranganna, S. (1986) Handbook of analysis and quality control for fruit and vegetables. Tata Mc. Graw Hill Publishing Company Limited. New Delhi -110 007. pp. 9-10.

Robbani, M., Sharfuddin, A. F. M. and Rabbani, M.G. (1996) Effect of growing conditions and GA3 on growth, yield and quality of grape cv. Zakkao. *Bangladesh Hort.* **24**(1&2): 71-75.

Salunkhe, D.K. and Kadam, S.S. (1995) Handbook of Fruit Science and Technology: Production, composition, storage and processing. 270 Madison Avenue New York-10016. pp. 7-31.

Singh, D. S., Pathak, R. A. and Singh, R.D. (1986) A note on the effect of thiourea on yield, ripening and quality of grape cv. pusa seedless. *Prog. Hort.* **18**(3-4): 216-217.

Received : September 04, 2006;
Accepted : February 22, 2007