NATURAL TREATMENTS FOR COLD TOLERANCE ON SNAP BEAN

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Abstract

Two field experiments were conducted at El-Baramoon Experimental Farm of Mansoura Horticultural Research Station, Horticultural Research Institute, Agriculture Research Center during 2006-2007 and 2007-2008 late fall seasons, on snap bean plants *cv.* Poulista. The study aimed to investigate the effect of some natural compounds as a foliar applications to alleviate the adverse effects of low temperature tolerant (cold stress), yeast (5, 10 and 15 g/L), vitamin B (25, 50 and 75 ppm) and adinosin-tri-phosphate (ATP) (50,100 and 150 ppm) in two different date planting times (20th October and 10th November). The obtained results showed that, first planting time was superior than the second one, also, all applied treatments ameliorated cold stress effects and significantly enhanced all growth parameters (plant height, number of branches per plant, number of leaves per plant, leaf area and plant fresh and dry weight), increased the concentrations of leaf mineral composition (N, P and K) of their plant foliage, beside improved pod yield and pod quality. The adinosin-tri-phosphate (ATP) at (150 ppm) concentration gave significant results in both planting dates in the two seasons.

INTRODUCTION

Snap bean (*Phaseolus vulgaris*, L.) is one of the most important leguminous crops grown in Egypt. It occupies a great figure in the local consumption and export. Also, snap bean is the leading source of protein and it is an important source of calories for many of the poor people in our country. Total area (fed.), total production (ton) and yield per fed. (ton) of snap bean were 73000, 330000 and 4.52 in 2007 season (according to statistics of Ministry of Agric., 2007, Egypt). Producing vegetable crops under change climate (especially cold tolerant) in old lands as well as new reclaimed lands faces a lot of challenges, i.e. unfavorable environmental conditions. This means that most vegetable crops grown under such conditions may suffer from various environmental stresses in the field. Enhancing growth and productivity under these conditions will be of a great importance to maximize the yield.

Fall season, under locality, is considered the main season for snap bean exportation, in which plants are periodically exposed to unfavorable wide differences between day and night temperatures and afterward to low temperatures in advanced fall season. Under such stressful environmental conditions and the consequences of exposure to relatively low temperature, reduction in yield and different performances could be expected (Buis *et al.*, 1988, Fryer *et al.*, 1995, Greaves, 1996 and Haldiman, 1998). Among the many physiological mechanisms responsible for these conditions is the potential for damage to the photosynthetic apparatus caused by the combination of low temperature and high light tolerant (Baker, 1994, Jones and Demmers-Derks, 1999). There was reduction in chlorophyll content, decrease in leaf size and an increase in leaf thickness, all typical of photo acclimation to increase irradiance (Bjorkman, 1981). The degree of plant tolerance to environmental stress varies greatly not only between species but in different varieties of the same species (Wentworth *et al.*, 2006). Therefore, some foliar applications, i.e., yeast, vitamin B as well as adenosine-tri-phosphate should be suggested to protect snap bean plants against adverse effects of environmental stress and improve productivity and quality under such conditions.

The use of adenosine-tri-phosphate (ATP) was reported in a narrow scale (Fathy and Farid, 2000 and Fathy *et al.*, 2000). Among such disturbances, adverse changes in structural and biochemical properties of photosynthetic and respiratory system (Macjejwesko *et al.*, 1984). Most of the basically ATP generating pathway, i.e. photophosphorylation, glycolysis, TCC-cycle and oxidative phosphorylation are restricted (Lyons and Briedenback, 1990 and OrtizLopez, 1991). Reduction in growth and protein synthesis, depletion in carbohydrate reserves, sever decrease in phosphorus uptake and ATP synthesis and accumulation of free toxic NH4+ lead to more expenditure of ATP in sequestering NH4+ into new nitrogen containing compounds (Sinclair, 1967 and Rabe and Lovatt, 1986). Mean while, high demand for ATP is actually fulfilled during the first few days of growth at low temperature (Sobezyk and KacperskaPalacz, 1978). Such demand should be very clear and urgent in plants of very limited chilling tolerance capacity as tomatoes and cucumber (Perras and Sarhan, 1984 and Sobczyk *et al.*, 1985).

Meanwhile, yeast treatments suggested to participate a beneficial role during tolerant due to its cytokinin content (Roberts, 1976 and Barnett *et al.*, 1990), improve the formation of flower initiation due to its effect on carbohydrates accumulation (Winkler *et al.*, 1962). Also, it was reported about its stimulatory effects on cell division and enlargement, protein and nucleic acid synthesis and chlorophyll formation (Kraig and Haber, 1980, Spencer *et al.*, 1983, Castelfranco and Beale, 1983 and Fathy and Farid, 1996). Add to its content of cryoprotective agent, i.e. sugars, proteins and amino acids and also several vitamins (Shady, 1978). Improving growth and fruiting of horticultural plants by yeast application was reported by Bowe *et al.*, (1989), Fathy and Farid (1996) and El-Mogy *et al.*, (1998). On the other hand vitamin B is a necessary ingredient for the biosynthesis of the co-enzyme thiamine pyrophosphate, in this latter from it plays an important role in carbohydrate metabolism. There are evidence that thiamin (vitamin B) can improve plant production. Oertli (1987) noted that it acts as co-enzyme necessary in vital process. El-Mansi *et al.* (1994 b) reported its effect in increasing root branching.

MATERIALS AND METHODS

Two field experiments were carried out at El-Baramoon Research Farm, El-Mansoura Horticulture Research Station, Horticulture Research Institute, Agricultural Research Center, Egypt, during two successive late fall seasons, 2006/2007 and 2007/2008. The experiments aimed to study the effect of two planting dates "20th October and 10th November", foliar application of yeast, vitamin B, adenosine-tri-phosphate (ATP) and their interaction on vegetative growth, yield and its components, as well as chemical constituents on snap bean (*Phaseolus vulgaris*, L. *cv.* "Poulista").

Experimental soil analysis:

The initial of some soil physical and chemical properties of investigated soil profile of cultivated area (0.0 to 50 cm depth) are given in Table (1) Methods of **Black (1965)** and **Page *et al.*, (1982)** were used for determinations.

The experimental design and treatments:

This study included 20 treatments, which were the combinations between two planting times and foliar application of ten growth promoters including control as follows:

Planting times

1) First planting date (20th October).
2) Second planting date (10th November).

Growth promoters

1. Control (tap water).
2. Yeast (5 g/L).
3. Yeast (10 g/L).
4. Yeast (15 g/L).
5. Vitamin B (25 ppm).
6. Vitamin B (50 ppm).
7. Vitamin B (75 ppm).
8. Adenosine-tri-phosphate (ATP) (50ppm).
9. Adenosine-tri-phosphate (ATP) (100ppm).
10. Adenosine-tri-phosphate (ATP) (150ppm).

These treatments were arranged in a split plot in a complete randomized block design with four replicates. The main plots were used for time of planting and the growth promoters were randomly arranged in the sub plots. The plot area was 17.5 m2 (5×5×0.7). It contained 5 rows with 5 m length and 0.7 m wide. The two outer rows were used for samples of vegetative growth traits and other rows were used for yield and its components.

Planting method:

Seeds were sown immediately in the moderately moist soil on October 20th and November 10th in both seasons. Seeds were sown in 5cm apart on one side of the row ridge.

Foliar applications

Yeast: Preparation of yeast solution was done according to El-Ghamriny *et al.*, (1999), where, Baker's yeast (soft yeast) was mixed with sugar at a ratio of 1:1 and left for 3 hours at room temperature, freezing for disruption of yeast tissue and releasing their content. Chemical and organic composition of yeast extract was determined according to Nagodowithana (1991) as shown in Table (2) and it was used at a concentration of 5, 10 and 15 g/L.

Vitamin B: It is a form of thiamin hydrochloride and was used at a concentration of 25, 50 and 75 ppm.

Adenosine-tri-phosphate (ATP): It was used at a concentration of 50, 100 and 150 ppm.

All foliar treatments (Yeast, Vitamin B and Adenosine-tri-phosphate) were applied three times at 30, 40 and 50 days after sowing.

Table 1. Initial of some soil physical and chemical properties of investigated soil profile of cultivated area

Soil properties		2006/2007	2007/2008
Physical analysis	Fine sand %	18.14	18.34
	Coarse sand %	7.71	7.91
	Silt %	33.65	33.45
	Clay %	40.50	40.30
	Texture	Clay-loam	Clay-loam
Chemical analysis	pH (in 1:5 soil water suspension extract)	8.11	8.10
	E.C. (dSm-1)	1.12	1.13
	Organic matter %	1.45	1.45
	Available P (ppm)	11.72	11.70
	CaCo3	4.55	4.58
	Total N %	0.2	0.2
Soluble anions (meq/L)	Cl-	3.56	3.46
	HCo-3	3.20	3.40
	Co-3	0.00	0.00
	So-4	5.16	5.26
Soluble cations (meq/L)	Ca++	4.03	4.03
	Mg++	1.35	1.35
	Na+	1.21	1.21
	K+	5.33	5.33
Available micronutrients (ppm)	Fe	3.62	3.62
	Mn	1.51	1.51
	Zn	1.35	1.35
	Cu	0.52	0.52

Table 2. Composition of yeast extract according to Nagodowithana 1991

Constituents	Value	Constituents	Value
Protein	47 %	Carbohydrates	33 %
Minerals	8 %	Nucleic acids	8 %
Lipids	4 %		
Approximate composition of vitamins			
Thiamine (B1)	60-100 m/g	Riboflavin (B2)	35-50 m/g
Niacin	300-500 m/g	Pyridoxine HCL (B6)	28 m/g
Pantorhenate (B4)	70 m/g	Biotin	1.3 m/g
Cholin	4000 m/g	Folic acid	5-13 m/g
Vitamin (B12)	0.001 m/g		
Approximate composition of minerals			
Na	0.12 mg/g	Cu	8.00 mg/g
Ca	0.75 mg/g	Se	0.10 mg/g
Fe	0.02 mg/g	Mn	0.02 mg/g
Mg	1.65 mg/g	Cr	2.20 mg/g
K	21.00 mg/g	Ni	3.00 mg/g
P	13.50 mg/g	Va	0.04 mg/g
S	3.90 mg/g	Mo	0.40 mg/g
Zn	0.17 mg/g	Sn	3.00 mg/g
Si	0.03 mg/g	Li	0.17 mg/g

Table 3. Monthly means of day temperatures during 2006/2007 and 2007/2008 fall seasons at El-Mansoura, Dakahlia governorate, Egypt.

	2006/2007			2007/2008		
	Max.	Min.	Mean	Max.	Min.	Mean
September	33.5	19.8	26.5	32.4	20.3	26.4
October	29.6	17.2	23.4	31.2	18.5	24.9
November	24.1	12.2	18.11	26.3	14.2	20.3
December	20.2	9.1	14.52	21.3	9.9	15.6
January	18.8	7.3	13.11	17.9	7.7	12.7
February	19.5	9.1	14.23	18.7	8.1	13.4

Recorded Data

Vegetative characteristics:

- Plant height
- Number of branches per plant
- Number of leaves per plant
- Total fresh weight/Plant
- Total dry weight/Plant
- Total leaf area/Plant.

Chemical composition: Leaves collected 60 days after sowing were oven dried at 70 °C until constant weight, 0.5 gm of dried mater were digested using H_2SO_4 and H_2O_2 as described by **Cottenie (1980)**. The extracts were used to determine the following chemical contents:

1. Nitrogen
2. Phosphorous
3. Potassium

Yield and its components: From the cumulative pod harvestings of each sub-plot, were harvested at the proper maturity stage, counted and weighed in each harvest and the following parameters were estimated:

- Average pod length (cm).
- Average pod weight (g).
- Average number of green pods/plant.
- Marketable yield (ton/fed).
- Non-marketable yield (ton/fed).
- Total fresh green pods yield (ton/fed.).

Green pods quality: Representative samples from green pods from each experimental plot were taken randomly for determining the following characteristics:

- Carbohydrates content.
- Protein content.
- Fibers content.

Statistical analysis:

The obtained data were subjected to statistical analysis of variance according to Snedecor and Cochran (1967). The treatment means were compared using the L.S.D. test as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Vegetative growth characteristics

Effect of planting dates: Data presented in Tables 4 and 5 show that the two planting times differed significantly in all growth characteristics, in the two seasons. The first planting time (20th October) resulted in higher values of all studied traits in the two seasons. The evidenced fact is that the plant growth is affected by genotype, therefore, such differences could be expected and utilized under a biotic stressful case like that in the present work (cold stress at late fall season, Table 3).

Effect of foliar application: It is obvious form Tables 4 and 5 that all foliar applications had significantly caused increments in all studied growth traits of snap bean in the two seasons. The exogenous ATP (150 ppm) spraying treatment had the highest effect followed by yeast (5 g/L) in both seasons. On the other hand, all spraying treatments had higher significant values than control treatment in both seasons.

It is a great benefit to give insight on the case of non-treated (control) plants which show the absolutely smallest values for all growth parameters during the two seasons. This indicates that these plants are dramatically affected by the prevailing low temperature (cold stress) (Table 3).

Furthermore, ATP treatment might be activated all of the ATP dependent metabolic process during stress (Menagle and Kirkby, 1982). Hydrolysis of ATP known to be a main process which readily and currently participated releasing the required energy, also ATP, ADP, AMP and in certain pathway AMP system, which links to alteration of gene expression to cold tolerance during stress via its role in signal transduction system (McClure *et al.,* 1989) might be involved. All of these discussed critical functions and advantages of ATP treatment confirmed the suggestion of the essentially of ATP exogenous application to counteract the adverse effect of cold stress and to enquired and alter snap bean plants to cold tolerance case.

The obtained results are in harmony with those of Fathy *et al.*, (2000) on tomato and Abd El-Kafie *et al.*, (2001) on chrysanthemum, who found that spraying plants with (ATP) increased vegetative growth parameters of plants as compared with the untreated ones. Concerning the beneficial effect of yeast it could be due to its essential bio-constituents contents, i.e. carbohydrate, protein, GAs, IAA, cytokinins and vitamins as well as mineral content. Besides, it might be due to its cytokinins content. Its stimulatory effect on cell division and enlargement, protein and carbohydrate synthesis as well as chlorophyll formation (Kraig and Haber, 1980, Castelfranco and Beale, 1983, Spencer *et al.*, 1983, Fathy and Farid, 1996).

Effect of interaction between planting date and foliar application: The effect of interaction of two planting times and natural foliar applications on plant vegetative growth characteristics of snap bean is presented in Tables 4 and 5. The interaction had positive significant effects on plant height, number of branches and leaves per plant, total leaf area per plant, fresh and dry weight per plant and its components compared with control, in both seasons.

Results indicated that plants treated with (ATP) at concentration (150 ppm) gave the highest values of vegetative growth parameters in both seasons followed by yeast at concentration (5 g/L), while the untreated plants gave the lowest values in both seasons. The previous explanation for the effect of ATP and yeast on snap bean plants grown in late fall season might explain the superiority of these treatments.

Chemical composition

Effect of planting date: Data in Table 6 clearly illustrate that, the two planting dates significantly affected in mineral composition in the two seasons. The first planting time (20^{th} October) resulted in higher values compared to second one (10^{th} November) for all studied parameters in both seasons.

This effect is certainly due to low temperature extremes (Table 3) which known to dramatically reduce the concentration of photosynthetic pigments and induce early senescence of the stressed plants. This depressive effect and response may be either due to impairment of chloroplasts, the site of chlorophyll synthesis, or due to degradation of these pigments followed by leaves and plant early senescence.

Effect of foliar application: Presented data in Table 6 show that all foliar applications significantly caused increments in leaves mineral composition and photosynthetic pigments compared with untreated plants in both seasons. It is a great benefit to give insight on the case of non-treated (control) plants which were dramatically and adversely affected by the prevailing low temperature (cold stress) during their growing seasons Table (3).

Same data show that ATP (150 ppm) gave the highest values for mineral composition and photosynthetic pigments above other treatments followed by yeast (5 g/L), in both seasons. The beneficial effect of ATP (150ppm) treatment superiority might be due to that it directly provided the stressed snap bean plants with either energy requirements or indirectly enhanced denovo synthesis of ATP (higher P content of this treatment could be considered such view point). So all ATP dependent metabolic processes, i.e. mineral uptake and carbohydrate and sugar metabolism might be enhanced. Additionally, applied ATP might be active H^+-ATP-ase membrane pumps (Reymond *et al.*, 1992), thereby increasing cations absorption (K, Ca and Mg) and in turn those activated such pumps in dynamic process inducing cold tolerance case (Palta, 1990). Besides, that (ATP) via it's cytokinins function (Jameson, 1994) might increase water and nutrients uptake and photo metabolites translocation by controlling sink source relationship.

Table 4. Snap bean plant height and number of branches and leaves per plant as affected by planting times, some foliar application and their interaction in late fall seasons of (2006/2007) and (2007/2008)

Treatments		Plant height (cm)		No. of branches/Plant		No. of leaves/Plant	
		I	II	I	II	I	II
A) Planting time							
First planting time		54.82	47.69	6.12	6.11	23.40	19.46
Second planting time		38.41	33.38	4.28	4.28	16.38	13.62
L.S.D at 5 %		0.18	0.16	0.10	0.16	0.08	0.06
B) Foliar application							
Control		35.78	38.10	4.34	4.28	17.90	14.31
Yeast 5 g/L		49.30	41.37	4.64	5.66	20.79	17.20
Yeast 10 g/L		46.24	39.55	4.60	4.98	18.95	15.82
Yeast 15 g/L		47.26	40.91	5.51	5.18	20.13	16.64
Vitamin B 25 ppm		48.02	41.27	5.58	5.56	20.31	17.20
Vitamin B 50 ppm		47.17	40.40	4.87	5.03	19.91	16.36
Vitamin B 75 ppm		46.24	39.86	4.71	4.79	19.73	16.30
A.T.P. 50 ppm		47.94	41.02	5.53	5.20	20.16	16.89
A.T.P. 100 ppm		47.20	40.40	5.24	5.17	19.96	16.59
A.T.P. 150 ppm		50.95	42.49	6.02	6.11	21.00	18.10
L.S.D at 5 %		1.24	0.21	0.08	0.72	0.08	0.14
C) Interaction							
First planting time	Control	42.1	44.8	4.1	5.0	21.1	16.3
	Yeast 5 g/L	58.0	49.6	6.6	6.6	24.4	20.2
	Yeast 10 g/L	45.4	46.5	5.4	5.8	22.3	18.6
	Yeast 15 g/L	55.6	48.1	6.4	6.1	23.6	19.8
	Vitamin B 25 ppm	56.5	47.3	6.5	6.5	23.9	20.2
	Vitamin B 50 ppm	55.5	47.5	5.7	5.9	23.4	19.2
	Vitamin B 75 ppm	54.4	46.9	5.5	5.6	23.2	19.1
	A.T.P. 50 ppm	56.4	48.2	6.5	6.1	23.7	19.9
	A.T.P. 100 ppm	55.5	47.5	6.1	6.1	23.4	19.2
	A.T.P. 150 ppm	59.7	50.2	7.1	7.1	24.7	21.3
Second planting time	Control	29.4	31.3	3.5	3.5	14.7	11.7
	Yeast 5 g/L	40.6	33.1	4.6	4.6	17.1	14.1
	Yeast 10 g/L	38.1	32.5	3.7	4.1	15.6	13.0
	Yeast 15 g/L	38.9	33.6	4.5	4.2	16.5	13.4
	Vitamin B 25 ppm	39.5	35.1	4.5	4.5	16.7	14.1
	Vitamin B 50 ppm	38.8	33.2	4.0	4.1	16.3	13.4
	Vitamin B 75 ppm	38.1	32.8	3.8	3.9	16.2	13.4
	A.T.P. 50 ppm	39.4	33.7	4.5	4.2	16.6	13.8
	A.T.P. 100 ppm	38.8	33.2	4.3	4.2	16.4	13.9
	A.T.P. 150 ppm	42.2	34.7	4.9	5.0	17.3	14.9
	L.S.D at 5 %	1.76	0.31	1.12	1.03	0.12	0.21

I: First season (2006/2007) II: Second season (2007/2008)

Table 5. Snap bean total leaf area per plant and total fresh and dry weight per plant as affected by planting times, some foliar application and their interaction in late fall seasons of (2006/2007) and (2007/2008)

Treatments		Leaf area/Plant (cm^2)		Total fresh weight (g)		Total dry weight (g)	
		I	II	I	II	I	II
A) Planting time							
First planting time		216.52	190.72	102.65	94.56	20.10	18.30
Second planting time		151.56	133.50	71.85	66.19	14.16	12.60
L.S.D at 5 %		1.11	0.27	0.80	0.74	0.46	0.14
B) Foliar application							
Control		168.35	151.19	82.31	77.31	16.04	14.93
Yeast 5 g/L		189.19	168.38	90.88	81.28	17.62	15.68
Yeast 10 g/L		176.78	155.73	87.15	80.88	17.44	15.61
Yeast 15 g/L		186.81	165.01	86.48	80.95	16.75	15.57
Vitamin B 25 ppm		188.17	166.05	89.10	80.04	17.40	15.40
Vitamin B 50 ppm		184.64	159.45	86.40	81.03	17.05	15.45
Vitamin B 75 ppm		178.35	158.31	84.75	79.58	16.71	15.20
A.T.P. 50 ppm		187.41	165.29	86.32	80.12	16.98	15.55
A.T.P. 100 ppm		168.67	160.26	88.07	78.67	17.60	15.17
A.T.P. 150 ppm		194.07	171.55	91.04	83.84	17.68	15.99
L.S.D at 5 %		2.14	0.54	0.25	0.33	0.45	0.42
C) Interaction							
First planting time	Control	198.1	177.8	96.84	90.96	18.68	17.64
	Yeast 5 g/L	225.3	198.1	106.92	95.63	20.88	18.69
	Yeast 10 g/L	207.9	183.2	102.54	95.16	20.32	18.53
	Yeast 15 g/L	219.7	194.1	101.75	95.24	19.62	18.49
	Vitamin B 25 ppm	218.6	195.3	104.82	94.17	20.30	18.12
	Vitamin B 50 ppm	217.2	187.5	101.65	95.33	19.95	18.53
	Vitamin B 75 ppm	209.8	186.2	99.71	93.63	19.64	17.79
	A.T.P. 50 ppm	220.4	194.3	101.56	94.26	19.88	18.54
	A.T.P. 100 ppm	219.6	188.5	103.62	92.55	20.69	17.94
	A.T.P. 150 ppm	228.3	201.8	107.11	98.64	21.04	18.69
Second planting time	Control	138.6	124.5	67.79	63.67	13.39	12.21
	Yeast 5 g/L	153.0	138.6	74.84	66.94	14.36	12.68
	Yeast 10 g/L	145.5	128.2	71.77	66.61	14.57	12.69
	Yeast 15 g/L	153.8	135.8	71.22	66.67	13.89	12.64
	Vitamin B 25 ppm	157.7	163.7	73.37	65.92	14.50	12.69
	Vitamin B 50 ppm	152.1	131.3	71.15	66.73	14.15	12.38
	Vitamin B 75 ppm	146.8	130.3	69.79	65.54	13.73	12.52
	A.T.P. 50 ppm	154.3	136.1	71.09	65.98	14.08	12.56
	A.T.P. 100 ppm	153.7	131.8	72.53	94.78	14.51	12.41
	A.T.P. 150 ppm	159.8	141.2	74.98	69.04	14.33	13.29
	L.S.D at 5 %	3.03	0.77	0.36	0.47	0.14	0.13

I: First season (2006/2007) II: Second season (2007/2008)

Meanwhile, beneficial effect of yeast could be due to its minerals, carbohydrates and hormones content (analysis of yeast preparation presented in Table 3) as well as to its reportedly favorable effects (Winkler *et al.*, 1962, Roberts, 1976, Castelfranco and Beale, 1983, Fathy and Farid, 1996, Fathy *et al.*, 2000). Likewise, yeast extract contains many components enhanced development and achieve stress tolerance, it also, with amino acids are vital for the synthesis of proteins (Yeo *et al.*, 2000, Amer, 2004, Less and Galili, 2008, Shokr and Fathy, 2009).

Moreover, data of mineral composition greatly confirmed the present results since, all treatments in similar fashion considerably improved N, P and K content in plant leaves, those which known to be directly or indirectly involved in chlorophyll formation, which in turn could be participated in maintaining chlorophyll content during such adverse condition.

Effect of interaction between planting date and foliar application: The combination among the two planting times and foliar applications reveal that the two studied planting times showed a similar positive response to the applied treatments compared with the untreated plants (control) in the two seasons (Table 6).

Also, from the same data, at the first planting time plants sprayed with ATP (150 ppm) had the highest value of leaf content of (N, P and K), followed by yeast extract (5 g/L).

Table 6. Snap bean leaves N, P and K content as affected by planting times, some foliar application and their interaction in late fall seasons of (2006/2007) and (2007/2008)

Treatments		N (%)		P (%)		K (%)	
		I	II	I	II	I	II
A) Planting time							
First planting time		3.08	2.54	0.40	0.30	2.44	2.11
Second planting time		2.70	2.16	0.33	0.23	2.16	1.83
L.S.D at 5 %		0.15	0.15	0.01	0.01	0.01	0.17
B) Foliar application							
Control		2.35	1.81	0.28	0.18	2.03	1.70
Yeast 5 g/L		3.34	2.69	0.45	0.35	2.46	2.13
Yeast 10 g/L		2.78	2.24	0.33	0.23	2.42	2.09
Yeast 15 g/L		3.06	2.52	0.39	0.29	2.21	1.88
Vitamin B 25 ppm		3.11	2.57	0.41	0.31	2.45	2.12
Vitamin B 50 ppm		3.03	2.49	0.37	0.27	2.36	2.03
Vitamin B 75 ppm		2.72	2.18	0.31	0.21	2.14	1.81
A.T.P. 50 ppm		2.50	1.96	0.30	0.20	2.14	1.81
A.T.P. 100 ppm		2.82	2.28	0.35	0.25	2.32	1.99
A.T.P. 150 ppm		3.34	2.80	0.45	0.35	2.47	2.14
L.S.D at 5 %		0.16	0.16	0.01	0.10	0.04	0.04
C) Interaction							
First planting time	Control	2.34	1.89	0.30	0.20	2.18	1.85
	Yeast 5 g/L	3.40	2.84	0.48	0.38	2.64	2.31
	Yeast 10 g/L	3.05	2.51	0.36	0.26	2.52	2.19
	Yeast 15 g/L	3.64	3.10	0.43	0.33	2.36	2.03
	Vitamin B 25 ppm	3.23	2.69	0.44	0.34	2.58	2.25
	Vitamin B 50 ppm	3.13	2.59	0.41	0.31	2.50	2.17
	Vitamin B 75 ppm	2.89	2.35	0.35	0.25	2.29	1.96
	A.T.P. 50 ppm	2.56	2.02	0.33	0.23	2.29	1.96
	A.T.P. 100 ppm	2.99	2.45	0.38	0.28	2.42	2.09
	A.T.P. 150 ppm	3.51	2.97	0.50	0.40	2.62	2.29
Second planting time	Control	2.28	1.74	0.26	0.16	1.88	1.55
	Yeast 5 g/L	3.06	2.52	0.42	0.32	2.29	1.69
	Yeast 10 g/L	2.50	1.96	0.31	0.21	2.33	2.00
	Yeast 15 g/L	2.48	1.94	0.34	0.24	2.06	1.73
	Vitamin B 25 ppm	2.98	2.44	0.39	0.29	2.32	1.99
	Vitamin B 50 ppm	2.93	2.39	0.34	0.24	2.23	1.90
	Vitamin B 75 ppm	2.56	2.02	0.28	0.18	1.99	1.66
	A.T.P. 50 ppm	2.44	1.90	0.27	0.17	2.00	1.67
	A.T.P. 100 ppm	2.66	2.12	0.32	0.22	2.21	1.88
	A.T.P. 150 ppm	3.17	2.63	0.41	0.31	2.33	2.00
	L.S.D at 5 %	0.23	0.23	4.53	4.64	0.06	0.06

I: First season (2006/2007) II: Second season (2007/2008)

Yield and its components

Effect of planting date: Concerning the effect of planting time on yield and its components, data presented in Tables 7 and 8 indicate that pod characteristics (weight, length) and yield parameters (pods number, marketable yield, non-marketable yield and total yield) were significantly caused increments by planting time in both seasons. The first planting time surpassed the second one in all studied parameters. This vitiated yield increases could be attributed to increases in plant growth, dry matter accumulation and mineral compositions increases Tables 4, 5 and 6.

In this respect, under Egyptian condition, it could be stated that snap bean plants may be positively affected and altered physiologically and metabolically to cold tolerance case and they became able to protect themselves against low temperature adverse effects. So, they can grow and yielded well even under such in conductive conditions (Table 3).

Effect of foliar application: As for the effect of foliar application on yield and its components data presented in Tables 7 and 8 indicate that foliar application of yeast, vitamin B and ATP were generally more effective than the control, where it exerted significant increases on pod parameters length, and weight and yield parameters such as pods number per plant, marketable and non-marketable yield and total yield in the first and second seasons, respectively.

Foliar applications, also significantly increased total yield per plant in both seasons, and significantly reduced non-marketable yield in the first and second seasons, respectively. The data showed also that, spraying with ATP (150 ppm) had the highest effect compared to other treatments followed by yeast (5 g/L). It is a great benefit to give insight on the case of non-treated (control) plants which show the absolutely lowest values for all growth parameters during the two seasons. This indicated that these plants are dramatically and adversely affected by the prevailing low temperature (cold stress) during their growing seasons (Table 3). The improving effect of ATP and yeast on yield and its components might be attributed to their positive role on enhancing photosynthesis, biosynthesis of proteins and carbohydrate assimilation diverted to the pods.

Herein, it could be suggested that the resultant improvement in yield and its components of snap bean cv. "Poulista" by the application of the mentioned effective treatments and also the depression in those of untreated plants under cold stress condition were logically true and expected, since the same treatments gave similar effect on growth parameters specially the resultant extension in surfaces of assimilation (leaf area) and the clear accumulation in the dry matter as well as on minerals content, those that reportedly were of several important function in alteration the plants to be in an internal active protective case against cold stress adverse effect, notice data in Table 3. Present results and interpretation are confirmed by the findings of Kubik and Michalczuk (1987), Reymond *et al.*, (1992) and Fathy *et al.*, (2000).

Effect of interaction between planting date and foliar application: Regarding the interaction effect of two planting times with natural foliar applications on snap bean yield and its components, data in Tables 7 and 8 show significant effects, in both seasons, on pod parameters (length and weight) and yield parameters (pods number, early yield marketable and non-marketable yield and total yield) as a result of interaction of the planting time and foliar application. Generally most studied characteristics of yield and its components had the highest values as a result of the interaction of first planting time (20th October) with foliar application of ATP (150 ppm).

These results may be due to the favorable conditions for good plant growth in the early stage during the first planting time compared to the late planting time.

Table 7. Mean pods weigh, length and number of pods of snap bean plants as affected by planting times, some foliar application and their interaction in late fall seasons of (2006/2007) and (2007/2008)

Treatments		Pod weigh (g)		Pod length (cm)		Pod number	
		I	II	I	II	I	II
A) Planting time							
First planting time		5.38	4.17	16.46	13.79	36.17	31.07
Second planting time		2.69	2.22	10.02	8.15	24.37	20.61
L.S.D at 5 %		0.18	0.76	0.57	0.53	0.41	1.92
B) Foliar application							
Control		3.68	2.72	10.69	9.14	26.30	23.57
Yeast 5 g/L		4.40	3.43	13.79	11.81	32.13	26.56
Yeast 10 g/L		4.01	2.98	13.55	11.15	29.38	26.16
Yeast 15 g/L		4.19	3.16	13.56	10.35	31.75	26.12
Vitamin B 25 ppm		3.78	3.12	13.72	11.57	31.92	25.30
Vitamin B 50 ppm		3.95	3.19	13.62	10.69	28.69	26.41
Vitamin B 75 ppm		3.91	3.17	13.15	11.41	31.08	25.20
A.T.P. 50 ppm		3.86	3.19	13.33	10.98	29.03	26.02
A.T.P. 100 ppm		3.92	3.38	13.03	10.81	28.96	25.79
A.T.P. 150 ppm		3.66	3.59	13.96	10.83	33.45	27.29
L.S.D at 5 %		0.32	0.31	0.78	0.47	0.52	1.49
C) Interaction							
First planting time	Control	5.04	3.93	13.47	11.63	31.43	28.06
	Yeast 5 g/L	5.64	4.22	17.12	14.78	38.42	31.65
	Yeast 10 g/L	5.33	4.14	16.83	14.00	35.12	31.42
	Yeast 15 g/L	5.50	4.11	16.84	13.06	37.97	31.34
	Vitamin B 25 ppm	5.28	4.11	17.02	14.50	38.03	30.10
	Vitamin B 50 ppm	5.36	4.17	16.90	13.46	34.22	33.58
	Vitamin B 75 ppm	5.35	4.11	16.36	14.31	37.16	30.04
	A.T.P. 50 ppm	5.25	4.10	16.57	13.80	34.91	31.14
	A.T.P. 100 ppm	5.23	4.11	16.22	13.60	34.56	30.82
	A.T.P. 150 ppm	5.87	4.68	17.30	14.81	39.87	32.61
Second planting time	Control	2.32	1.51	7.92	6.64	21.12	19.06
	Yeast 5 g/L	3.17	2.64	10.47	8.84	25.84	21.47
	Yeast 10 g/L	2.69	1.82	10.28	8.30	23.61	20.90
	Yeast 15 g/L	2.88	2.20	10.28	7.64	25.53	20.91
	Vitamin B 25 ppm	2.29	2.14	10.41	8.65	25.80	20.51
	Vitamin B 50 ppm	2.54	2.21	10.33	7.92	23.16	19.25
	Vitamin B 75 ppm	2.47	2.23	9.95	8.51	24.99	20.35
	A.T.P. 50 ppm	2.46	2.27	10.09	8.16	23.16	20.90
	A.T.P. 100 ppm	2.61	2.66	9.85	8.02	23.37	20.76
	A.T.P. 150 ppm	3.44	2.50	10.61	8.86	27.03	21.98
	L.S.D at 5 %	0.45	0.45	1.10	0.66	0.73	2.12

I: First season (2006/2007) II: Second season (2007/2008)

Table 8. Marketable and nonmarketable yield and total yield of snap bean plants as affected by planting times, some foliar application and their interaction in late fall seasons of (2006/2007) and (2007/2008)

Treatments		Marketable yield (ton/fed.)		Nonmarketable yield (ton/fed.)		Total yield (ton/fed.)	
		I	II	I	II	I	II
A) Planting time							
First planting time		5.25	4.94	0.45	0.43	5.71	5.38
Second planting time		3.51	3.29	0.30	0.28	3.81	3.58
L.S.D at 5 %		0.10	0.27	0.01	0.02	0.11	0.29
B) Foliar application							
Control		3.53	3.39	0.62	0.59	4.16	3.99
Yeast 5 g/L		4.67	4.27	0.35	0.32	5.03	4.59
Yeast 10 g/L		4.25	4.22	0.34	0.34	4.59	4.56
Yeast 15 g/L		4.51	4.17	0.39	0.36	4.90	4.54
Vitamin B 25 ppm		4.55	4.23	0.34	0.31	4.89	4.55
Vitamin B 50 ppm		4.23	4.10	0.36	0.35	4.60	4.46
Vitamin B 75 ppm		4.36	4.09	0.38	0.35	4.75	4.44
A.T.P. 50 ppm		4.14	3.88	0.41	0.38	4.55	4.27
A.T.P. 100 ppm		4.23	4.01	0.31	0.30	4.55	4.31
A.T.P. 150 ppm		5.31	4.79	0.27	0.25	4.59	5.05
L.S.D at 5 %		0.12	0.19	0.01	0.01	0.14	0.20
C) Interaction							
First planting time	Control	4.23	4.07	0.74	0.72	4.98	4.79
	Yeast 5 g/L	5.59	5.15	0.34	0.38	6.02	5.54
	Yeast 10 g/L	5.09	5.05	0.31	0.41	5.50	5.46
	Yeast 15 g/L	5.45	5.06	0.47	0.44	5.93	5.44
	Vitamin B 25 ppm	5.45	5.07	0.41	0.38	5.86	5.46
	Vitamin B 50 ppm	5.07	4.91	0.44	0.42	5.51	5.34
	Vitamin B 75 ppm	5.23	4.90	0.45	0.42	5.68	5.32
	A.T.P. 50 ppm	4.96	4.65	0.49	0.46	5.45	5.11
	A.T.P. 100 ppm	5.07	4.80	0.38	0.36	5.45	5.17
	A.T.P. 150 ppm	6.37	5.82	0.33	0.30	6.71	6.13
Second planting time	Control	2.83	2.71	0.50	0.47	3.34	3.18
	Yeast 5 g/L	3.75	3.38	0.28	0.25	4.04	3.64
	Yeast 10 g/L	3.41	3.38	0.27	0.27	3.68	3.66
	Yeast 15 g/L	3.57	3.35	0.31	0.29	3.88	3.64
	Vitamin B 25 ppm	3.65	3.40	0.27	0.25	3.93	3.65
	Vitamin B 50 ppm	3.40	3.29	0.29	0.28	3.69	3.58
	Vitamin B 75 ppm	3.50	3.28	0.30	0.28	3.81	3.57
	A.T.P. 50 ppm	3.32	3.11	0.32	0.30	3.65	3.42
	A.T.P. 100 ppm	3.39	3.22	0.25	0.24	3.65	3.46
	A.T.P. 150 ppm	4.24	3.77	0.22	0.19	4.46	3.97
	L.S.D at 5 %	0.18	0.27	1.91	2.72	0.19	0.29

I: First season (2006/2007) II: Second season (2007/2008)

Green pod quality

Effect of planting times: Data illustrated in Table 9 show that pods quality properties of snap bean pods expressed as carbohydrates, proteins and fibers were significantly affected by planting times.

The first planting time (20th October) resulted in higher values for all studied traits compared to the second planting time (10th November) in both seasons. The evidenced fact is that the pod quality is affected mostly by genotype, therefore, such differences could be expected and utilized under a biotic stressful case like the present work in which the cold stress/late fall season that shown in Table 3. Similar variations under stress condition were obtained by Fathy *et al.*, (2000).

Effect of foliar application: It is evident from Table 9 that all foliar applications had a significant enhancement on all pod quality characteristics aspects of snap bean, i.e. acidity, carbohydrates, proteins and fibers than those of control plants. They mostly differed considerably among them in both seasons.

It is a great benefit to give insight on the case of non-treated (control) plants which show the absolutely lowest values for all growth parameters during the two seasons. This indicates that these plants are dramatically and adversely affected by the prevailing low temperature (cold stress) during their growing seasons Table 3.

It is clear from the same data that ATP at a concentration 150 ppm gave the highest values for all studied characteristics followed by yeast treatment (5 g/L) during the two seasons.

Herein, it could be suggested that the resultant improvement in fruiting, yield and quality of snap bean plant cv. "Poulista" by the application of mentioned effective treatments and also the depression in those of untreated plants under cold stress condition were logically true and expected, since the same treatments gave similar effect on growth parameters specially the resultant extension in surface of assimilation (leaf area) and the clear accumulation in dry matter (Table 4 and 5) as well as on carbohydrates and sugars synthesis and minerals content (Table 6) that were of several important function in alteration the plants to be in an internal active protective case against cold stress adverse effect, notice data in Table 3. Present results and interpretation are confirmed by the findings of Sinclair (1967), Macjejwesko *et al.*, (1984), Kubik and Michalzuk (1987), Frank (1990), Soliman (1992), Reymond *et al.*, (1992), Younis *et al.*, (1992) and Njoroge *et al.*, (1988).

Effect of interaction between planting time and foliar application: Concerning the interaction effect of two planting times and foliar applications on pod quality of snap bean, data in Table 9 show increases in pod quality characteristics (carbohydrates, proteins and fibers) in the plants which sprayed with ATP (150 ppm) in the first planting time (20th October) compared with the second one (10th November).

Table 9. Snap bean green pod content of total carbohydrates, proteins and fibers as affected by planting times, some foliar application and their interaction in late fall seasons of (2006/2007) and (2007/2008)

Treatments		Carbohydrates (%)		Proteins (%)		Fibers (%)	
		I	II	I	II	I	II
A) Planting time							
First planting time		17.85	16.30	4.32	4.25	13.17	12.15
Second planting time		16.07	14.53	3.60	3.40	12.7	11.62
L.S.D at 5 %		0.002	0.15	0.11	0.75	0.29	0.15
B) Foliar application							
Control		16.08	14.46	3.16	2.96	16.13	15.1
Yeast 5 g/L		17.37	15.79	4.32	4.08	10.44	9.32
Yeast 10 g/L		17.13	15.64	3.56	3.43	12.26	11.25
Yeast 15 g/L		17.21	15.67	3.92	4.06	12.94	12
Vitamin B 25 ppm		16.74	15.20	4.11	3.83	12.68	11.66
Vitamin B 50 ppm		16.77	15.26	3.28	3.20	13.39	12.19
Vitamin B 75 ppm		17.19	15.66	3.42	3.53	14.4	13.49
A.T.P. 50 ppm		16.28	14.75	4.00	3.73	14.67	13.55
A.T.P. 100 ppm		16.81	15.27	3.69	3.76	12.91	11.75
A.T.P. 150 ppm		18.01	16.46	6.09	5.65	9.51	8.53
L.S.D at 5 %		0.04	0.17	0.97	0.76	0.38	0.42
C) Interaction							
First planting time	Control	16.92	15.23	3.45	3.53	16.57	15.57
	Yeast 5 g/L	18.29	16.67	4.75	4.50	10.59	9.38
	Yeast 10 g/L	17.50	16.03	3.88	3.53	12.45	11.47
	Yeast 15 g/L	18.12	16.57	4.28	4.53	13.22	1238
	Vitamin B 25 ppm	17.35	15.81	4.49	4.26	13.02	11.99
	Vitamin B 50 ppm	17.93	16.39	3.58	3.53	13.55	12.51
	Vitamin B 75 ppm	18.62	17.11	3.73	3.66	14.54	13.77
	A.T.P. 50 ppm	17.14	15.61	4.37	4.06	14.90	13.74
	A.T.P. 100 ppm	17.70	16.15	4.03	4.33	13.25	12.01
	A.T.P. 150 ppm	18.96	17.42	6.65	6.53	9.58	8.71
Second planting time	Control	15.23	13.69	2.87	2.40	15.7	14.63
	Yeast 5 g/L	16.46	14.91	3.93	3.66	10.3	9.26
	Yeast 10 g/L	16.45	15.24	3.23	3.33	12.06	11.03
	Yeast 15 g/L	16.30	14.76	3.56	3.60	12.66	11.62
	Vitamin B 25 ppm	16.13	14.59	3.74	3.40	12.33	11.33
	Vitamin B 50 ppm	15.62	14.14	2.98	2.86	13.23	11.86
	Vitamin B 75 ppm	15.76	14.22	3.11	3.40	14.26	13.22
	A.T.P. 50 ppm	15.43	13.88	3.64	3.40	14.5	13.37
	A.T.P. 100 ppm	15.93	14.38	3.36	3.20	12.56	11.5
	A.T.P. 150 ppm	17.06	15.51	5.54	4.76	9.43	8.36
	L.S.D at 5 %	0.06	0.25	1.38	1.08	0.53	0.59

I: First season (2006/2007) II: Second season (2007/2008)

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المعاملات الطبيعية لمقاومة آثار البرودة علي الفاصوليا

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نفذت تجربتان حقليتان في المزرعة البحثية بالبرامون التابعة لمحطة بحوث البساتين بالمنصورة، محافظة الدقهلية خلال موسمي الزراعة ٢٠٠٦/٢٠٠٧ و ٢٠٠٧/٢٠٠٨ في العروة الخريفية المتأخرة على نبات الفاصوليا صنف بوليستا، لدراسة تأثير ميعاد الزراعة وبعض معاملات الرش الورقي الطبيعية وهي الخميرة بتركيزات (٥ – ١٠ – ١٥ جم/لتر) وفيتامين ب بتركيزات (٢٥ – ٥٠ – ٧٥ جزء في المليون) والأدينوذين تراي فوسفات (ATP) بتركيزات (٥٠ – ١٠٠ – ١٥٠ جزء في المليون(لتخفيف الأثر السلبي للحرارة المنخفضة (إجهاد البرودة) على النباتات بهدف تحسين مكونات المحصول وصفات الجودة للقرون تحت هذه الظروف.

تم تصميم التجربة بنظام القطع المنشقة مرة واحدة في ثلاث مكررات حيث احتوت على ٢٠ معاملة بواقع ٢ ميعاد زراعة (الميعاد الأول ٢٠ أكتوبر – الميعاد الثاني ١٠ نوفمبر) و ٩ معاملات رش وأخيراً معاملة المقارنة، وقد تم رش النباتات ٣ مرات أولها بعد ٣٠ يوم من الزراعة ثم كل ١٠ أيام.

وكانت أهم النتائج التي أمكن الحصول عليها مايلى:

١- تفوق الميعاد الأول للزراعة (٢٠ أكتوبر) علي الميعاد الثاني (١٠ نوفمبر) في الصفات التي تمت دراستها ومنها صفات النمو الخضري ، التركيب الكيماوي ومكونات المحصول وجودته.

٢- خففت جميع المعاملات تأثيرات إجهاد البرودة وحسنت بصورة معنوية جميع صفات النمو الخضري (طول النبات – عدد الأفرع – عدد الأوراق/نبات – مساحة السطح الورقي/النبات – الوزن الطازج والجاف).

٣- أدت إضافة المعاملات إلى زيادة محتوى الأوراق من العناصر المعدنية (النيتروجين – الفسفور – البوتاسيوم).

٤- زاد المحصول وكذلك صفات الجودة الطبيعية والكيميائية للثمار بصورة معنوية نتيجة لاستخدام معاملات الرش.

كانت أعلى النتائج المتحصل عليها المعاملة بالأدينوذين تراي فوسفات (ATP) (١٥٠ جزء في المليون) حيث أعطت هذه المعاملة أعلى نتائج معنوية في كلا الميعادين في الموسمين على التوالي.