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GROWTH AND PROTEIN CONTENT OF WHEAT KERNELS TREATED WITH THREE GROWTH REGULATORS

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النمو والمحتوى البروتيني لحبوب القمح المعاملة بثلاثة من منظمات النمو

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تمت دراسة تأثير رش جرعات مختلفة من الآلار ، الازولام ، أو الكينيتين عل النمو والمحتوى البروتيني لحبوب القمح . زاد الوزن الطازج للحبوب عند المعاملة بتركيزات ٢٠٠، ٢٠٠٠ مجم/لتر الار ، و ٥ ، ٢٥ ، ٧٥ مجم/لتر ازولام ، بينما تسببت المعاملة بتركيزات ٥٠ ، ١٠٠ مجم/لتر كينيتين في زيادة الوزن الطازج للحبوب عند عمر ٤٦ ، ٦٠ يوم من تكوينها . تسببت جميع المعاملات في زيادة الوزن الجاف للحبوب زيادة معنوية . وقد أدت المعاملة بالالار إلى نقص المحتوى البروتيني للحبوب فيما عدا تركيز ٢٠ مجم/لتر الار ، الذي زاد من هذا المحتوى عند عمر ٤٦ ، ٦٠ يوم أما المعاملة بالازولام والكينيتين فقد أدت إلى زيادة ملحوظة في المحتوى البروتيني للحبوب ، خاصة تركيز ٢٠٠ مجم كينيتين .
أوضحت هذه الدراسة عدم حدوث أية تأثيرات ضارة لهذه المواد عل النمو المحتوى البروتيني لحبوب القمح عند استخدامها بالرش على النباتات .

Key Words: Alar, Asulam, Growth, Kernels, Kinetin, Protein content, Triticum aestivum

ABSTRACT

Alar, asulam or kinetin at different doses were sprayed on wheat plants and their effects on growth and protein of the developing kernels were investigated. Grain fresh matter was significantly increased in response to 200 and 2000 mg/L alar as well as to 5, 25 and 75 mg/L asulam. Also, kinetin at 50 and 100 mg/L caused an increase in grain fresh matter on 46 and 60 days post-anthesis. Grain dry matter was significantly increased in response to all doses of the treatments. Alar at all doses caused a decrease in grain protein, except for 20 mg/L which increased the protein on 46 and 60 days post-anthesis. An obvious increase in grain protein occurred with all doses of asulam and kinetin. The highest protein content was observed with the highest does of kinetin (200 mg/L).

INTRODUCTION

Mehrotra *et al.* (1983) demonstrated that alar was able to decrease the dry matter production and increased the grain protein of wheat.

In celery plants, Watts and Collin (1979) were first to show that asulam could affect both fresh weight and dry matter production.

Humphries (1958) reported that there was a reduction in dry matter of potatoes following kinetin treatment .Furthermore, Hegazy *et al* (1972) stated that kinetin had a great role in the regulation of protein accumulation .In the present investigation a detailed work was conducted using wheat plants treated by foliar spray of certain concentrations of alar, asulam and kinetin. At harvest time the grains were studied for their f.wt., dry matter and protein content. The project mainly hoped to decide whether any of these growth regulators could be of value when applied to wheat cultivation.

MATERIALS AND METHODS

1- Growth Conditions

A homogenous lot of wheat grains (*Triticum aestivum* L. var. Giza 157) were sown in earthen-ware pots (30 cm in diameter) filled with loamy -sand soil Fifteen grains were sown in each pot and seeded pots were kept in glass house in

which plants were subjected to 16/8 day-night hours cycles .and a temperature of 28 ± 2°C. Irrigation was carried out when required. After two weeks, thinning was started so that ten uniform seedlings were left in each pot for the following study. The pots were divided into 4 sets, 60 pots each . Plants of the first set were maintained untreated to serve as controls and were sprayed with water and Tween 20. Each of the other sets were subdivided into three groups of 20 pots. Plants in the 2nd set were foliar sprayed with alar "B-995" (N-dimethyl amino succinamic acid) at concentrations of 20, 200 and 2000 mg/L. Plants in the 3rd set were foliar sprayed with asulam (methyl 4-amino benzene sulphonyl carbamate) at concentrations of 5,25 and 75 mg/L. Those of the 4th set were sprayed with kinetin (6-furfuryl amino purine) at concentrations of 50,100 and 200mg/L Spraying of the treatment solutions were applied when the plants were 32-days old i.e. after emergence of the 4th leaf. In all cases, Tween 20 (1 c.c./L) as a wetting agent, was added to the employed chemicals to be sprayed. Triplicate samples from fresh grains were taken at random from each concentration per treatment after 23 (milking stage) 46, 53 (grain filling) 60,80days (grain maturation) post -anthesis

Methods: For fresh and dry weight determination, samples of 10 grains from every concentration of treatment were randomly taken at the specified time intervals. The mean values (per grain) were estimated as mg per grain.

The protein content of fresh grains was determined colorimetrically as described by Lowry *et al.*, (1951). The results were first subjected to an analysis (ANOVA). If the ANOVA showed significant ($P < 0.05$) effect, the least significant difference was performed (Snedecor and Cochran, 1967).

Table 1

Changes in fresh weights of developing wheat grains as affected by different concentrations of alar, asulam and kinetin. Values are expressed as mg. f.wt. grain^{-1}

Treatment	Days after anthesis 23	46	53	60	80
Control	25.0	36.7	47.0	39.5	30.6
Alar					
20 mg/L	27.8	37.9	37.9	35.0	36.5
200 mg/L	30.0	38.6	53.6	38.0	29.2
2000 mg/L	31.0	59.7	64.9	36.7	34.2
Asulam					
5 mg/L	31.2	48.7	58.9	44.2	40.4
25 mg/L	31.0	47.9	63.7	46.0	36.8
75 mg/L	30.0	38.5	52.0	36.5	33.6
Kinetin					
50 mg/L	1.8	44.5	41.0	36.3	29.1
100 mg/L	16.7	32.3	45.8	46.7	33.9
200 mg/L	20.0	39.8	46.2	33.5	30.6
L.S.D. 5%	3.7	2.4	2.3	2.9	4.0
L.S.D. 1%	5.2	3.4	3.2	4.1	5.5

RESULTS

1. Changes in fresh weight of developing wheat grains (Table 1):

In controls, maximum f.wt. of grains was recorded at 53d post anthesis. Foliar spray of alar at 200 and 2000 mg/L and asulam at 5, 25 and 75 mg/L resulted in a significant increase ($p<0.05$) in grain f.wt. On the other hand, with 50 and 100 mg/L kinetin, the highest values of grain f.wt. were obtained after 46 and 60 days respectively, but never improved grain yield. However, with 200 mg/L kinetin, the values of grain f.wt. at 46, 53 and 809 days were more or less comparable to those of control. Moreover, such concentration of kinetin led to a significant decrease in grain f.wt. on the 23rd and the 60th days as compared to control values.

2. Changes in dry weight of developing wheat grains (Table 2):

In control plants, the grains dry matter reached a maximum value after 60 d. Maximum dry matter of grain occurred in most cases of treatments at 60 d post-anthesis except with 2000 mg/L alar and with 50 mg/L kinetin which appeared to hasten dry matter accumulation in grain by one week.

Table 2

Changes in dry weights of developing wheat grains as affected by different concentrations of alar, asulam and kinetin. Values are expressed as mg. d.wt. grain^{-1}

Treatment	Days after anthesis 23	46	53	60	80
Control	8.2	18.9	26.0	26.8	24.8
Alar					
20 mg/L	10.1	20.5	24.1	28.5	32.9
200 mg/L	9.1	15.2	25.4	29.0	31.0
2000 mg/L	5.8	26.9	44.5	31.5	27.2
Asulam					
5 mg/L	14.7	25.5	33.7	35.2	34.4
25 mg/L	10.9	28.9	31.9	33.9	33.2
75 mg/L	8.6	29.4	30.4	31.0	30.3
Kinetin					
50 mg/L	5.1	25.0	29.1	27.5	26.3
100 mg/L	5.5	23.3	24.2	30.9	30.7
200 mg/L	7.5	22.3	25.4	31.0	27.5
L.S.D. 5%	1.7	1.5	1.2	1.0	3.0
L.S.D. 1%	2.4	2.1	1.7	1.4	4.2

3. Changes in protein content of developing wheat grains (Table 3):

It is obvious that in control plants the values of protein content of wheat grains during the growth period were similar at days 23 and 46, but increased significantly on day 53. Upon grain maturation, a marked decrease in protein content was observed on day 60 afterwards it increased sharply on day 80.

Table 3
Changes in protein content of developing wheat grains as affected by different concentrations of alar, asulam and kinetin. Values are expressed as mg protein g^{-1} f.wt.

Treatment	Days after anthesis				
	23	46	53	60	80
Control	66.5	63.4	82.9	38.9	114.8
Alar					
20 mg/L	61.8	79.3	65.5	117.6	114.0
200 mg/L	63.7	89.2	87.9	44.7	96.5
2000 mg/L	50.6	65.1	95.1	46.7	104.9
Asulam					
5 mg/L	85.9	93.6	93.2	79.0	118.3
25 mg/L	95.5	104.3	135.7	73.0	146.9
75 mg/L	76.6	89.9	105.6	71.7	108.5
Kinetin					
50 mg/L	90.7	115.4	91.2	53.5	126.3
100 mg/L	185.3	105.6	110.4	163.4	173.8
200 mg/L	140.0	146.4	200.6	139.9	256.8
L.S.D. 5%	2.3	2.3	3.5	11.1	6.8
L.S.D. 1%	3.1	3.1	4.8	15.5	9.5

As is shown in Table 3 alar at all doses used caused a marked decrease in grain protein content on days 23 and 80 except with 20 mg/L which was not different from controls on day 80 and a marked increase on days 46 and 60. The protein content of grains treated with 25 mg/L asulam appeared to be the highest of all concentrations used. All doses of kinetin used (50, 100 and 200 mg/L) caused increases in protein content during filling, the highest dose of kinetin (200 mg/L) caused the maximum accumulation of protein in the ripening grains.

DISCUSSION

The results herein indicate that in control wheat plants there was a progressive increase in grain f.wt. up to the 53rd day post-anthesis, and thereafter a sharp decline was observed. However, maximum grain dry weight was obtained on the 60th day. Such pattern of changes is consistent with those results reported for barley (Mounla & Michael, 1973) and wheat (Bangerth *et al* 1985) grains of untreated plants.

The present investigation further indicated that the observed increase in fresh and dry weights of wheat grain following alar treatment may presumably be explained on the basis that alar enhances accumulation of carbohydrates within the grain particularly during the early stages of grain development (Mansour *et al* 1988).

The noticed increase in either fresh or dry weight of weight grains as a result of asulam application may probably suggest that asulam acts directly or indirectly as a stimulant for the synthesis and/or activity of enzymes responsible for dry matter accumulation in grains. In support of our findings, it may be mentioned that Watts & Collin (1979) found that incubation of celery cell suspension in asulam caused an increase in dry weight.

The present results indicated that kinetin enhanced the accumulation of dry matter within the developing grains. This may be explained by the fact that kinetin stimulates a mobilization center, thus directing the migration of substances and their accumulation into the developing grains. This is in agreement with the results of Hegazy *et al* (1972).

As far as protein is concerned, the present results showed that the protein content of control plants was markedly reduced after 60 days. This may probably be due to low accumulation and partition of reduced-N accumulated during the vegetative stage of growth and low relative contribution of nitrate assimilation and N-redistribution during grain development. Alternatively, there may be an increase in proteolytic activity at that stage (Reed *et al* 1980).

These observations further indicated that alar caused a marked decrease in protein content of wheat grains at early stages of grain development but appeared to cause a marked increase in protein level up to day 60 post-anthesis. In this respect Kartynshina *et al* (1970) pointed out that spraying wheat plants with 0.3% chlormequat solution during stem elongation stage increased crude protein in all plant parts. It was also shown that B-9 at 500 ppm increase significantly the protein content of tropical Senji seeds (Mohan & Yadava, 1985).

Asulam at all doses caused a significant increase in protein content of wheat grains during their development. It seems likely that asulam interferes with the activity of proteinases. An increase in proteinase activity was associated with an increase in the loss of soluble protein (Feller *et al* 1977). It may be of interest to mention that asulam has also been reported to cause an inhibition of RNA and protein synthesis (Mann *et al* 1965, Keitt, 1969, Moreland *et al* 1969, Hepler & Jackson, 1969).

The obvious increase in protein contents of grain as a result of kinetin application may be due to the fact kinetin enhances the absorption of nitrogenous compounds from the soil, as was suggested by Hegazy *et al* (1972).

Since the application of the aforementioned chemicals was associated with certain changes in grain growth and protein levels, this might have occurred due to an alteration in the balance of the endogenous hormonal levels in the developing grain. Therefore, the study of the changes in the levels of phytohormones in the developing wheat grains is warranted. This will be in fact the subject of the next paper.

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