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# CHANGES IN BIOCOMPONENTS OF CHICKPEA (*CICER ARIETINUM* L.) SPRAYED WITH POTASSIUM NAPHTHENATE AND NAPHTHALENE ACETIC ACID

**MD. FAZLUL KARIM, QUAZI ABDUL FATTAH[1] AND A. B. M. KHALEDUZZAMAN[2]**

*Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh*

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**Abstract**

Foliar spray of 1500 ppm KNap and 10, 20 and 30 ppm NAA, either alone or in combination, on chickpea significantly increased the crude protein by 1.3% over control. When carbohydrate contents in seeds increased the protein content decreased and vice versa. Crude fibre and ash contents were high with 1500 KNap plus 20 NAA, but fat contents decreased. 1500 KNap treatment increased isoleucine, leucine, lysine, phenylalanine and valine. Amino acids like alanine, aspartic acid, glutamic acid, serine and tyrosine were considerably increased due to 1500 KNap plus 20 NAA. Arginine, glycine and serine contents were maximium with 1500 KNap plus 10 NAA treatment.

## Introduction

There are 22 amino acids that constitute thousands of different proteins formed in human bodies. Of these, eight amino acids are not synthesized by the human body, and they are supplied with foods. The most commonly used cereals and vegetables have minimum level of proteins, which are incomplete in their amino acids pattern as required by human body (Desai and Khanvilkar 1977). Pulses are a major source of amino acids in our dietary schedules. Chickpea (*Cicer arietinum* L.) is an important pulse crop. But its yield level in Bangladesh is poor in comparison to that of other countries of the world. In Bangladesh, attempts are being made to improve quantitative status of chickpea employing different agronomical managements but less emphasis was given towards its qualitative improvement. Among the possible ways of promoting chickpea seed quality application of cost effective growth regulators have been used elsewhere (Desai and Khanvilkar 1977, Dhingra *et al.* 1995) but not in Bangladesh. It is established that growth regulators act at the gene level of plant influencing the translational and transcriptional mechanisms (Key 1969) and on the transaminase enzyme level (Fattah *et al.* 1979) for protein synthesis. Hence, the present experiment was undertaken to study the effectiveness of two growth regulators such as, KNap and NAA as foliar spray on the improvement of biochemical components, specially amino acids *vis-à-vis* protein content, in chickpea seeds.

## Materials and Methods

A field experiment was carried out during the Rabi season (November to March) in 2001-2002 on a silty-loam soil of the research field of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. The treatments were all foliar sprays (conc. on ppm) at 45 days after sowing (DAS) as follows: $T_0$ = water control; $T_1$ = 1500 KNap; $T_2$ = 10 NAA; $T_3$ = 20 NAA; $T_4$ = 30 NAA; $T_5$ = 1500 KNap followed by 10 NAA; $T_6$ = 1500 KNap followed by 20 NAA and $T_7$ = 1500 KNap followed by 30 NAA. The experiment was laid out in a randomized complete block design (RCBD) with four replications. The unit plot size was 6 m × 4.4 m. Urea, TSP, MP, gypsum and

[1]Department of Botany, University of Dhaka, Dhaka-1000, Bangladesh. [2]Animal Nutrition Section, Dept. of Livestock Services, Farmgate, Dhaka, Bangladesh.

boric acid were applied during final land preparation at the rate of 20 kg N, 40 kg $P_2O_5$, 20 kg $K_2O$, 20 kg S and 1 kg B/ha, respectively. Seeds of chickpea cv. BARI chhola-6 were sown on 25th November 2001 in rows with 40 cm distance between rows. The seeds were sown as solid line and plants in rows were maintained 10 cm apart by thinning excess plants at 15 DAS. Intercultural operations were done according to the necessity of crop.

Foliar spray of KNap and NAA were applied in the early hours of morning on plants at first flowering stage (45 DAS). Tween-20 was mixed with the solutions of growth regulators as wetting agent. Separate spray machines were used for the two growth regulators. Application of KNap was followed by NAA application on the same plot as the combination treatment. During spraying each plot was isolated by covering each with thick polythene sheet to avoid crossing over and mixing up of a particular growth regulator to the next plot.

The crop was harvested at 113 days after sowing. Biochemical compositions of harvested matured whole seeds were determined according to Ma and Zuazaga (1942) for crude protein and National Institute of Nutrition (NIN 1976) for moisture, fat, crude fibre, ash and carbohydrate. The compositions of amino acids in seeds were determined using the High Performance Liquid Chromatography (HPLC) technique (AOAC 1995). Data of protein and carbohydrates contents following treatments were analyzed statistically (Steel and Torrie 1960) and treatment means were compared by LSD (least significant difference) method. The statistical analysis was not done in case of amino acids.

**Results and Discussion**

Crude protein, carbohydrate, crude fiber, fat, ash and amino acids were found positively influenced due to the use of two growth regulators, KNap and NAA as compared with those of controls.

It was revealed that the crude protein content in seeds varied from 19.65 to 20.95% across different treatment levels (Table 1). Highest protein content (20.95%) in seeds was obtained with 1500 KNap plus 20 NAA ($T_6$) and it was followed by 1500 KNap ($T_1$), 10 NAA ($T_2$), 20 ($T_3$) and 30 NAA ($T_4$) alone or in combination. The lowest content was observed in control seeds ($T_0$). Treatment $T_6$ gave increased seed protein content by 1.3% over control.

Unlike protein content $T_6$ decreased the carbohydrate (CHO) content. The CHO in seeds was found significantly maximum (63.48%) with $T_3$ and followed by $T_0$. The lower content (60.24%) was shown by $T_5$ and was at per with $T_6$ and $T_2$.

Crude fibre and ash contents (9.93 and 3.60%, respectively) were appreciably high with $T_6$. The lower fibre and ash contents (7.94 and 3.32%, respectively) were the resultant effect of $T_3$ and $T_0$. Fat content was maximum (6.06%) with $T_5$ and minimum (4.63%) with $T_6$.

Comparable results were also reported earlier. Fattah *et al.* (1979) suggested that foliar application of appropriate concentration of 2500 KNap on maize plants stimulated activity of transaminase leading to more protein synthesis. Jahan (1995) found higher content of protein over control in seeds of soybean using 2500 KNap. Mondal (1999) obtained higher oil content in rapeseed due to the use of 1000 KNap.

In this study, chickpea treated with 20 NAA resulted in higher crude protein contents in seeds (20.49%) over control (19.65%), and this was similar to that of many other works. Desai and Khanvilkar (1977) obtained higher protein content (23.99%) of chickpea with 100 NAA.

Dhingra *et al.* (1995) found increased protein content and decreased starch contents in chickpea seeds with 20 NAA than those of controls.

The reverse relation between carbohydrate and protein contents in seeds were noticed by scientists. Desai and Khanvilkar (1977) reported decreased carbohydrate contents with higher protein contents while applying five growth regulators on chickpea. Khan and Kaul (1982) also observed a similar relationship between amylose and protein contents in rice varieties.

Bhatia and Robson (1976) mentioned that decrease in carbohydrate contents may be attributed to greater investment of energy for protein synthesis at the cost of increased degradation of carbohydrates.

**Table 1. Carbohydrate, protein, fat, crude fibre and ash contents of dry seeds of chickpea as affected by KNap and NAA treatments.**

| Treatments | Carbohydrate (%) | Crude protein (%) | Crude fibre (%) | Fat (%) | Ash (%) |
|---|---|---|---|---|---|
| $T_0$ | 63.23 ab | 19.65 b | 8.69 | 5.11 | 3.32 |
| $T_1$ | 61.91 bc | 20.74 a | 8.95 | 4.96 | 3.44 |
| $T_2$ | 61.36 cd | 20.46 a | 8.80 | 5.98 | 3.40 |
| $T_3$ | 63.48 a | 20.49 a | 7.94 | 4.74 | 3.35 |
| $T_4$ | 61.79 c | 20.40 a | 8.38 | 6.00 | 3.43 |
| $T_5$ | 60.24 d | 20.86 a | 9.32 | 6.06 | 3.52 |
| $T_6$ | 60.89 cd | 20.95 a | 9.93 | 4.63 | 3.60 |
| $T_7$ | 62.06 bc | 20.44 a | 8.84 | 5.28 | 3.38 |
| LSD 0.05 | 1.41 | 0.71 | - | - | - |
| CV % | 1.55 | 2.37 | | | |

The profile of amino acids (Table 2) showed that alanine, arginine, aspartic acid, glutamic acid, glycine, isoleucine, leucine, lysine, phenylalanine, serine, threonine, tyrosine and valine varied from 0.83 - 0.91, 1.67 - 1.94, 2.02 - 2.12, 3.18 - 3.68, 0.84 - 1.02, 0.81 - 0.94, 1.67 - 1.72, 1.52 - 1.60, 1.09 - 1.23, 1.02 - 1.09, 0.74 - 0.82, 0.54 - 0.69 and 0.71 - 0.86%, respectively across

**Table 2. Amino acid* composition (% of DM) of chickpea seeds as affected by KNap and NAA.**

| Tr. | Glu* | Asp | Arg | Leu | Lys | Phe | Ser | Gly | Ile | Ala | Val | Thr | Tyr | TA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_0$ | 3.21 | 2.02 | 1.67 | 1.70 | 1.52 | 1.10 | 1.02 | 0.84 | 0.82 | 0.83 | 0.81 | 0.78 | 0.55 | 16.87 |
| $T_1$ | 3.29 | 2.07 | 1.84 | 1.74 | 1.60 | 1.23 | 1.07 | 0.97 | 0.94 | 0.89 | 0.86 | 0.81 | 0.61 | 17.92 |
| $T_2$ | 3.18 | 2.03 | 1.68 | 1.71 | 1.54 | 1.15 | 1.05 | 0.87 | 0.82 | 0.86 | 0.85 | 0.82 | 0.54 | 17.10 |
| $T_3$ | 3.19 | 2.04 | 1.85 | 1.72 | 1.55 | 1.12 | 1.03 | 0.94 | 0.81 | 0.85 | 0.78 | 0.78 | 0.60 | 17.26 |
| $T_4$ | 3.20 | 2.03 | 1.71 | 1.67 | 1.53 | 1.10 | 1.04 | 0.90 | 0.82 | 0.84 | 0.76 | 0.74 | 0.57 | 16.91 |
| $T_5$ | 3.62 | 2.06 | 1.94 | 1.71 | 1.52 | 1.09 | 1.09 | 1.02 | 0.89 | 0.89 | 0.86 | 0.82 | 0.65 | 18.16 |
| $T_6$ | 3.68 | 2.12 | 1.84 | 1.72 | 1.60 | 1.10 | 1.09 | 0.95 | 0.90 | 0.91 | 0.84 | 0.80 | 0.69 | 18.24 |
| $T_7$ | 3.24 | 2.05 | 1.67 | 1.68 | 1.52 | 1.11 | 1.05 | 0.86 | 0.82 | 0.85 | 0.71 | 0.79 | 0.59 | 16.94 |

*Glu = Glutamic acid, Asp = Aspartic acid, Arg = Arginine, Leu = Leucine, Lys = Lysine, Phe = Phenylalanine, Ser = Serine, Gly = Glycine, Ile = Isoleucine, Ala = Alanine, Val = Valine, Thr =Threonine, Tyr = Tyrosine, TA = Total amino acid.

the treatment variations. Treatment with 1500 KNap ($T_1$) was most effective in increasing the contents of amino acids like isoleucine, leucine, lysine, phenylalanine and valine over other treatments. Treatments with 10 NAA ($T_2$) and 1500 KNap plus 10 NAA ($T_5$) produced seeds with more threonine content. Amino acids like alanine, aspartic acid, glutamic acid, serine and tyrosine were considerably increased in seeds with 1500 KNap plus 20 NAA ($T_6$) over other treatments. Arginine, glycine and serine were found maximum with treatment 1500 KNap plus 10 NAA ($T_5$). The highest content of total amino acids were noted against $T_6$, and it was followed by $T_5$ and $T_1$. The minimum was recorded in $T_0$.

The amino acid contents as influenced by KNap had not been reported on any crop elsewhere. However, there are reports on effects of other growth regulators on amino acids contents in chickpea seeds. Desai and Khanvilkar (1977) reported that some amino acid like argenine, cystine, histidine, isoleucine, leucine, lysine, methionine, threonine, tryptophan, tyrosine and valine were increased over control due to the use of 2 ppm Atrataf, 10 ppm 2, 4-D and 50 ppm GA. They also found increased arginine, histidine, threonine and tyrosine contents with 100 NAA. Dhingra *et al.* (1995) found increased free amino acids in chickpea seeds with the application of 20 ppm NAA and 1 ppm BAP. Activities of nitrate reductase, transaminase, glutamate dehydro-genase, adenosine triphosphate, phosphorylase and amylase in different crops were influenced with appropriate growth regulators could explain greater accumulation of amino acids for maximum protein synthesis (Fattah 1969, Cruz *et al.* 1970, Wu *et al.* 1972, Fattah and Bano 1978).

Seed protein content and seed yield relationship were found nonsignificant (Fig. 2). Opinions, however, differed or agreed with respect of the relations between the two parameters were given by Khan (1981) and Jahan (2001) in soybean and rice while treated with KNap.

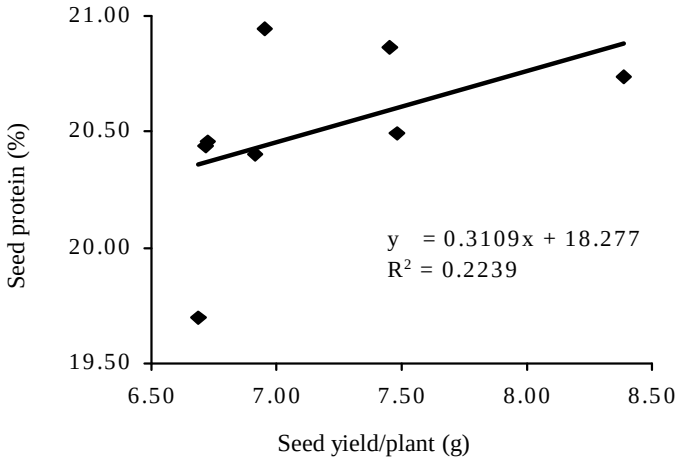


Fig. 1. Relationship between seed protein and seed yield of chickpea.

The overall results obtained showed that 1500 KNap alone or in combination with 10 or 20 NAA, improve seed quality of chickpea. The enzymatic study of chickpea plant with KNap and NAA application would be the future research work for further justification of the positive influence of KNap or NAA for quality seeds.

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