

GROWTH ANALYSIS OF CHICKPEA CV. BARI CHHOLA-6 AS AFFECTED BY FOLIAR SPRAY OF GROWTH REGULATORS

MD. FAZLUL KARIM* AND QUAZI ABDUL FATTAH¹

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

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Abstract

Leaf area index (LAI), leaf area duration (LAD), crop growth rate (CGR), net assimilation rate (NAR) and above ground dry matter accumulation (AGDM) of a cultivar of chickpea (*Cicer arietenum*) were studied with the application of potassium naphthenate (KNap) and naphthalene acetic acid (NAA) as foliar spray in 2001-2002. The growth regulators had greater influence on plants which showed comparable values of LAI, LAD, CGR, NAR and TDM over control plants. Out of the growth regulator treatment, 1500 ppm KNap produced 26.7 to 37.5% more TDM at different stages of growth than those of control, and it was superior to other treatments with NAA. Other growth parameters also increased following 1500 ppm KNap treatment. LAI, CGR, NAR and AGDM had a significant linear relationship with seed yield. The combination treatments of KNap and NAA concentrations did not show any cumulative influence on any of the parameters.

Introduction

The leaf area and its duration are important consideration for photosynthesis of a plant. These are also the measurements of growth of plants and plant physiological processes. LAI and LAD control total dry matter production and subsequently yield attributes and yield (Katiyar 1980, Jirali *et al.* 1994). Khanna-Chopra and Sinha (1987) observed that leaf senescence which starts during pod formation stage eventually affect the development of pods of chickpea. Leaf area and other growth parameters were influenced by different growth regulators in pulse crops (Fattah and Wort 1970, Islam *et al.* 2006 and Ullah 2006). The present investigation was undertaken to study the effect of KNap and NAA on some physiological parameters of chickpea plants.

Materials and Methods

A field experiment was done during November to March (Rabi season) of 2001-2002 on a silty-loam soil of Sher-e-Bangla Agricultural University farm, Dhaka, Bangladesh. The eight foliar treatments were tested as follows: T₀ = water spray (control); T₁ = 1500 ppm KNap; T₂ = 10 ppm NAA; T₃ = 20 ppm NAA; T₄ = 30 ppm NAA; T₅ = 1500 ppm KNap followed by 10 ppm NAA; T₆ = 1500 ppm KNap followed by 20 ppm NAA and T₇ = 1500 ppm KNap followed by 30 ppm NAA. The foliar treatments were applied at 45 days after sowing (DAS). 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. Fertilizers were added as urea, TSP, MP, gypsum and boric acid at the rate of 20 kg N, 40 kg P₂O₅, 20 kg K₂O, 20 kg S and 1kg B ha⁻¹, respectively before sowing. Seeds of chickpea cv. BARI chhola-6 were sown on 25 November, 2001 in rows having a gap of 40cm. The seeds were sown continuously and plants in rows were maintained 10 cm apart by thinning seedlings at 15 DAS. This gave a plant density of 25 × 10³ plants ha⁻¹. Intercultural operations were done as and when needed. Separate spray machines were used for application of two growth regulators. During spraying plots were separated by thick polythene sheet to check contamination.

*Corresponding author. E-mail: pdmfkarim@yahoo.com, ¹Department of Botany, University of Dhaka, Dhaka-1000, Bangladesh.

Data of different parameters were recorded from ten plants selected at random for each treatment at 45, 83, 95 and 113 DAS as corresponding growth stages of first flowering, pod setting, pod filling and maturity, respectively. Leaf area was measured using a leaf area meter and the LAI and LAD were calculated by using the formula of Hunt (1978). CGR and NAR were calculated following Brown (1984) and Radford (1967), respectively. Above ground plant parts were separated and dried in an oven at 80°C for 48 hours and the dry weights were taken after cooling in desiccators by an automatic digital balance and then above ground dry matter was calculated by adding all the dry weights of plant parts. Data were analyzed statistically and treatment means were compared by LSD test.

Results and Discussion

Effects on leaf area index (LAI) and leaf area duration (LAD): Plants treated with 1500 ppm KNap showed appreciable increase in LAI and LAD from reproductive stage to maturity (83-113 DAS) (Figs. 1 and 2). The maximum LAI was recorded at the time of pod development stage (95 DAS) in all treatments. At 95 DAS, following 1500 KNap (T₁) treatment gave maximum value of LAI (4.23) and it was followed by 1500 KNap plus 10 NAA (T₅) and 20 NAA (T₃). The treatment with 1500 KNap (T₁) was dominating and increased 56.5, 19.8 and 4.6% LAI at 83, 95 and 113 DAS, respectively over controls. Leaf area duration was maximum during 45-83 DAS. From early age to maturity, 1500 KNap showed significantly highest LAD followed by 20 NAA at 95-113 DAS. The longer duration of leaves produced more dry matter. The control plants, grown without

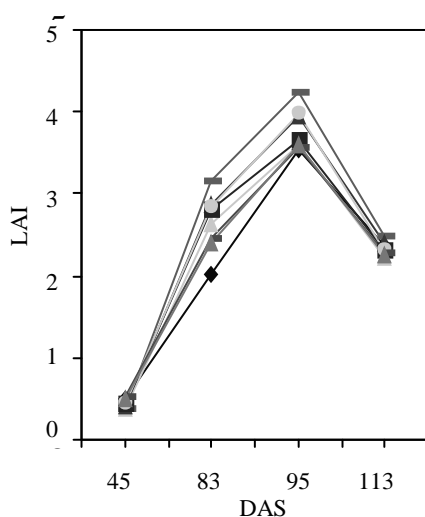


Fig.1. Leaf area index of chickpea as affected by growth regulators. —◆— T0, — T1, —▲— T2, —▲— T3, —■— T4, —●— T5, — T6, —▲— T7

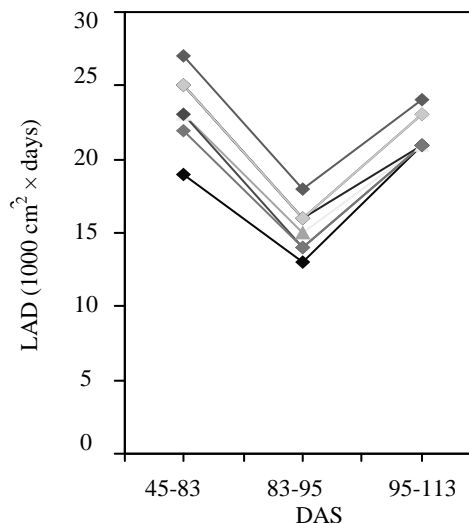


Fig. 2. Leaf area duration of chickpea as affected by growth regulators. —◆— T0, — T1, —▲— T2, —▲— T3, —■— T4, —●— T5, — T6, —▲— T7

growth regulator treatment, resulted in minimum LAI and LAD. LAI fell between 95 and 113 DAS in all treatments as plant had greater leaf senescence. The senescence of leaves was remarkably greater in control plants. Ullah *et al.* (2002) obtained increase in leaf area in foxtail millet due to different KNap treatments. Patil *et al.* (1990) obtained higher leaf area index of chickpea with 20 ppm NAA. Ullah (2006) obtained increased LAI in cowpea plants with 1250-1300 ppm KNap and 50 NAA separately. Mondal and Fattah (1997) recorded higher and similar leaf areas with 1000 ppm KNap and 2 ppm mixtalol, respectively.

In the present study LAI/plant has significantly positive and linear relationship ($R^2 = 0.9142^{**}$) with seed yield of chickpea (Fig. 3). Similar relationship was obtained by Motior *et al.* (1997) in winged bean.

Effects on crop growth rate (CGR) and net assimilation rate (NAR) ; The peak crop growth rate (CGR) value was observed at pod development stage (83-95 DAS) following all the treatments (Fig. 4). 1500 ppm KNap gave maximum values of CGR at 45-83 DAS ($3.84 \text{ g m}^{-2} \text{ day}^{-1}$), 83-95 DAS ($11.08 \text{ g m}^{-2} \text{ day}^{-1}$) and 95-113 DAS ($3.64 \text{ g m}^{-2} \text{ day}^{-1}$) which were statistically similar to those of T₅ at 45-83 DAS ($3.69 \text{ g m}^{-2} \text{ day}^{-1}$), of T₃ at 83-95 DAS ($9.80 \text{ g m}^{-2} \text{ day}^{-1}$) and at 95-113 DAS ($3.42 \text{ g m}^{-2} \text{ day}^{-1}$).

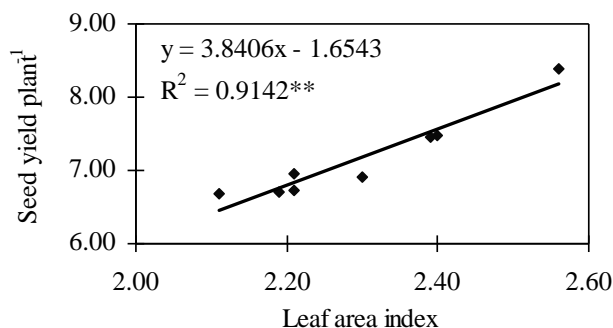


Fig. 3. Relationship between leaf area index and seed yield of chickpea plants.

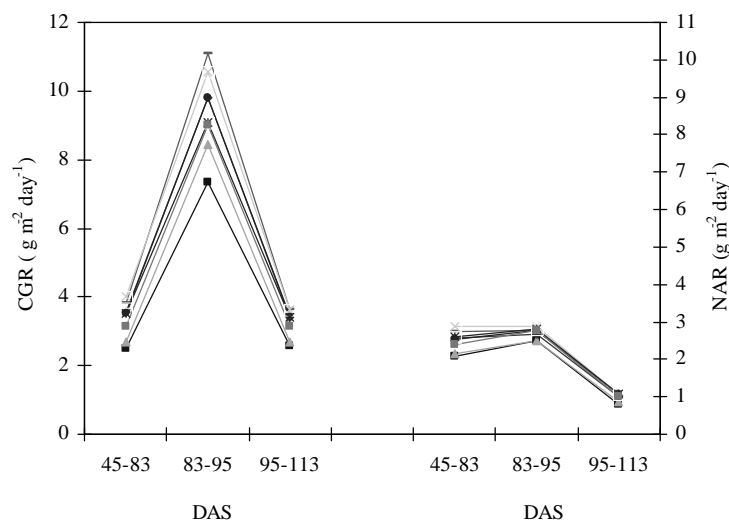


Fig. 4. Crop growth rate and net assimilation rate of chickpea plants as affected by growth regulators.

—■— T0, —■— T1, —▲— T2, —◆— T3, —●— T4, —✧— T5, —■— T6, —✱— T7

1500 ppm KNap showed significantly higher net assimilation rates from early ages till maturity (Fig. 4). At 45-83, 83-95 and 95-113 DAS the NAR values were 2.98 , 3.02 , and $1.11 \text{ g m}^{-2} \text{ day}^{-1}$, respectively. Treatment T₁ was followed by T₅, T₃ and T₆ at 45-83 DAS; T₃ and T₅ at 83-95 DAS; T₃, T₅, T₄ and T₆ at 95-113 DAS in respect of NAR values. The maximum NAR was recorded at pre-flowering to pod development stages in all treatments and after that it decreased

until maturity. Mondal and Fattah (1997) found 1000 KNap as effective growth regulator in producing increased CGR and NAR of rapeseed. Ullah *et al.* (2006) showed increased CGR and NAR with 1250-1300 KNap and 50 NAA than those of controls in cowpea plants.

Increased crop growth rate and net assimilation rate indicate the optimum physiological growth of a crop that produces maximum seed yield as reported by Mondal and Fattah (1997) in rapeseed and by Ullah *et al.* (2006) in cowpea. In the present study the crop growth rate ($R^2 = 0.873^{**}$) and net assimilation rate ($R^2 = 0.8311^{**}$) have significant positive relationship with seed yield of chickpea plants and that is linear (Figs. 5 and 6). The similar relationships were obtained by Mondal and Fattah (1997) in rapeseed.

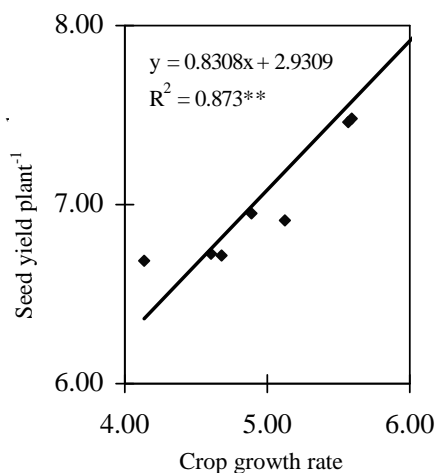


Fig. 5. Relationship between crop growth rate and seed yield of chickpea plants.

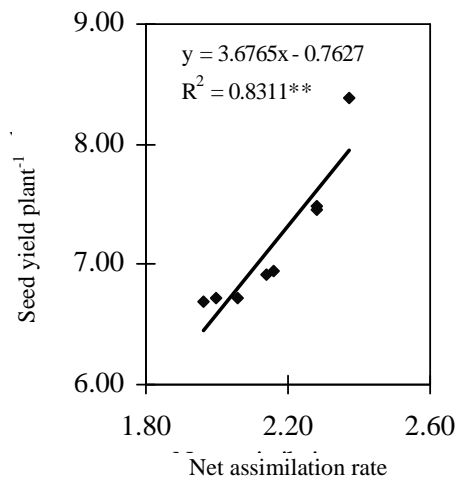


Fig. 6. Relationship between net assimilation rate and seed yield of chickpea plants.

Effects on above ground dry matter (AGDM) of plant and its partition: Above ground dry matter is the total dry matter of stems, leaves, flowers and pods which accumulated in the plant slowly up to 45 DAS and then rapidly increased till maturity. This finding was similar to that of another experiment of Karim and Fattah (2003) while they treated chickpea plants with different concentrations of potassium naphthenate.

Stem dry weight increased progressively till maturity of the crop whereas leaf dry weight increased up to 95 DAS and then declined. Treatment 1500 ppm KNap (T_1) produced maximum stem dry weight and leaf dry weight between 83 and 113 DAS than other treatments (Table 1). Irrespective of treatment differences stem dry matter accounted for 38.4, 44.9 and 37.9% and leaf dry matter accounted for 61.5, 51.7 and 20.8% at vegetative, pod setting and maturity stages, respectively. 1500 ppm KNap showed 21.1% more flower dry weight over control at 83 DAS. In case of pod dry weight, treatment T_1 produced maximum amount at 95 and 113 DAS and these were superior to other treatments. Treatment T_1 registered 34.6 to 36.1% more pod production over control at 95 and 113 DAS (Table 1). Pod accounted for 3.4 and 41.3% dry matter at pod setting and maturity stages, respectively. Similar trend of dry matter partition was noticed by Karim and Fattah (2003) in chickpea and by Islam *et al.* (2006) in lentil.

In this study, the greater above ground dry matter (AGDM) observed from 83 to 113 DAS (6.69 - 14.63 g plant⁻¹) (Fig. 7). Plants sprayed with 1500 ppm KNap gave 26.7-37.5% more dry matter over controls in all the stages. The next influential treatment was found to be 20 ppm NAA in producing more AGDM. The increase in total dry weight in plants could be attributed to

maximum accumulation of assimilates in different parts of plants during growth and development of chickpea crop with greater LAI and NAR values. Dry matter/plant has significant and linear relationship with seed yield of chickpea plants ($R^2 = 0.8755^{**}$) (Fig. 8).

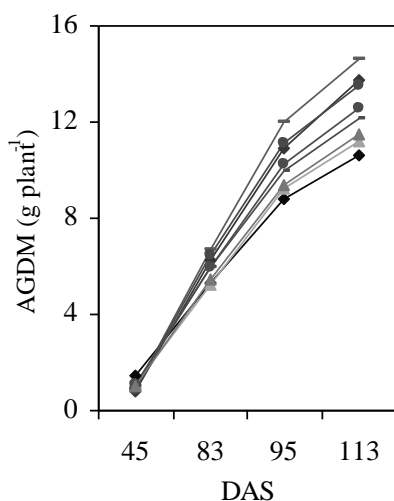


Fig. 7. Above ground dry matter of chickpea plants at different ages as affected by growth regulators.

—◆— T0, —■— T1, —▲— T2, —◇— T3,
—●— T4, —○— T5, —□— T6, —△— T7.

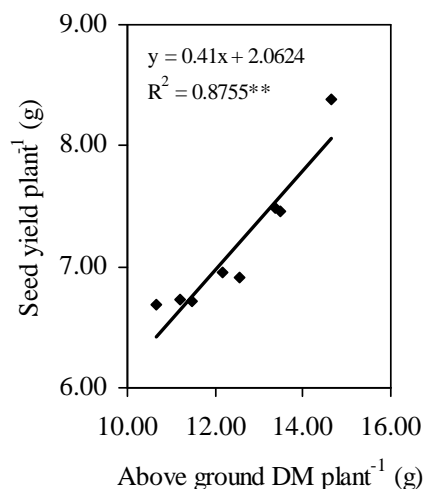


Fig. 8. Above ground dry matter of chickpea plants at different ages as affected by growth regulators.

Table 1. Dry weights (g/plant) of stem, leaf, flower and pod of chickpea cv. BARI chhola-6 at different ages as affected by growth regulators.

Treatment	Stem dry wt. on different DAS				Leaf dry wt. on different DAS				Flower dry wt.	Pod dry wt. on different DAS		
	45	83	95	113	45	83	95	113		83	95	113
T ₀	0.64	2.37 c	3.02 e	4.09 c	0.83 a	2.72d e	3.69 d	2.27 d	0.19	2.08 e	4.29 f	
T ₁	0.30	2.99 a	4.12 a	5.63 a	0.56 bc	3.47 a	5.09 a	3.16 a	0.23	2.80 a	5.84 a	
T ₂	0.43	2.35 c	3.23 e	4.25 c	0.69 b	2.69 e	3.84 cd	2.37 cd	0.19	2.20 de	4.59 ef	
T ₃	0.27	2.80 ab	3.79 b	5.07 b	0.57 bc	3.21 a-c	4.52 b	2.81 b	0.22	2.62 b	5.51 ab	
T ₄	0.39	2.64 bc	3.62 bc	4.85 b	0.68 b	3.13 bc	4.03 c	2.65 bc	0.20	2.62 b	5.05 cd	
T ₅	0.32	2.88 ab	3.84 b	5.06 b	0.53 c	3.37 ab	4.60 b	2.80 b	0.21	2.67 ab	5.65 ab	
T ₆	0.41	2.74 ab	3.51 cd	4.45 c	0.60 bc	3.01 cd	3.97 c	2.36 cd	0.20	2.47 c	5.37 bc	
T ₇	0.42	2.44 c	3.26 de	4.35 c	0.63 bc	2.79 de	3.89 cd	2.34 cd	0.19	2.25 d	4.79 de	
LSD (0.05)	NS	0.29	0.25	0.40	0.14	0.29	0.24	0.32	NS	0.15	0.40	
CV (%)	22.97	7.41	4.85	5.78	15.14	6.44	3.86	8.33	11.25	4.13	5.33	

Values followed by the same alphabet in a vertical column do not differ significantly at 5% level.

Islam *et al.* (2006) found significantly greater shoot dry weights over control spraying 1500 ppm KNaP and 40 ppm NAA on lentil. Ullah *et al.* (2002) reported increased dry weight in foxtail millet plants due to KNaP treatments. Bangal *et al.* (1983) reported 25 or 50 ppm NAA as influential growth regulators to increase pod weight of chickpea. Ullah (2006) reported greater TDM with 1250-1300 ppm KNaP and 50 ppm NAA separately while those spraying on cowpea plants.

Results obtained indicated that 1500 ppm potassium naphthenate if sprayed on chickpea plants at first flowering stage (45 DAS) could be positively effective for growth and development of plants with higher values of physiological characteristics.

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