OnLine Journal of Biological Sciences 2 (10): 669-671, 2002
ISSN 1608-4127

Influence of KNap and Mixtalol on Chlorophyll a, b and Carotenoid Content of Rapeseed Leaf

Ferdousi Begum, [1]M.A. Kader, [2]M.Y. Sarker, S.M. Raquibullah, M.D. Hossain and [2]Zahid-Al-Rafique
Bangladesh Agricultural Research Institute, Gazipur, Bangladesh
[1]Gazipur Collectorate, Gazipur, Bangladesh
[2]Bangladesh Jute Research Institute, Dhaka, Bangladesh

Abstract: An experiment was conducted to study the effect of 1000 and 1500 ppm KNap and 2 ppm mixtalol on chlorophyll a, b and carotenoid content of rapeseed leaf. Results showed that chlorophyll a, b and carotenoid content of leaves were positively affected by 1000 ppm KNap and 2 ppm mixtalol but 1500 ppm KNap was failed to show any significant positive effect on chlorophyll content of rapeseed leaf. Two years mean results showed increased chlorophyll a, b and carotenoid content of leaves of rapeseed plant over control following 2 ppm mixtalol and 1000 ppm KNap single and double spray treatments.

Key words: Rapeseed, KNap, mixtalol, chlorophyll a, b, carotenoid

Introduction

There are twelve recommended varieties of rapeseed/mustard and most of them are high yielding and responsive to high management practices (Akbar and Alam, 1995). Moreover, some varieties have shattering problem during ripening stage. So to increase total production increase yield per unit area of land is a must in Bangladesh. This increase can be achieved by using improved varieties and by adopting improved technology and input in the field level (Ahmed, 1995).

Plant growth hormones are a group of naturally occurring organic substances which influence physiological processes at a very low concentration. The processes influence mainly on growth differentiation and development, though other processes such as stomatal movement may also be affected. Plant growth and development are generally regulated by genetical and physiological principles and environmental factors but they may also be influenced by phytohormones, or plant growth regulators (PGRs). Presently PGRs are used to control a host of physiological processes in crop production including flowering and fruiting, partitioning of assimilates, germination, growth suppression, defoliation and post harvest ripening (Teharan, 1978). Some growth regulators if applied judiciously increase beneficial vegetative growth, photosynthetic area and leaf pigments, reduces the abscission of flowers and immature fruits and thus maximizes the total production of crops. In India, several phytohormones are recommended for commercial use to increase yield of many crop plants (Srivastava and Menon, 1987). In Bangladesh, researchers have been exploring possibility of increasing the yield of a number of crops including oil yielding ones. Chlorophylls, the green pigments of plants, are the most important pigments active in the photosynthetic process. Chlorophyll a,b and carotenoid are photosynthetic pigments, the pigments are the most important on this conversion of light energy to chemical energy that exist with in the chloroplasts or cromatophores of plants. These pigments are also influenced by growth regulators. Potassium naphthenate and mixtalol are two growth regulators which regulate growth and development in plants, fruit setting and growth, growth of flower parts and fruit ripening etc. Potassium naphthenate (KNap) and mixtalol, two synthetic growth regulators are being used experimentally for increasing yields of many crop plants. The effects of KNap on different varieties of rapeseed and mustard were studied by Hoque *et al.* (1992) and Khanom (1992) with varying concentrations of potassium naphenate and encouraging research results were obtained from those experiments. Chlorophyll a,b and carotenoid content of leaf may also be influenced by growth regulators. So, the present experiment was undertaken to study their effect on chlorophyll content of leaf of rapeseed variety BARI sarisha-6 (Dhali).

Materials and Methods

The experiment was conducted at the Central Research Station of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during the period from November to February, 1998-99 and 1999-00 two consecutive years. Rapeseed variety BARI sharisha-6 (Dhali) was used for the study. There were seven treatments (T) including control as follows:

T_0 = water spray at 22 and 30 days after emergence (control)
T_1 = foliar application of 1000 ppm KNap at 22 DAE (days after emergence)
T_2 = foliar application of 1000 ppm KNap at 22 and 32 DAE
T_3 = foliar application of 1500 ppm KNap at 22 DAE
T_4 = foliar application of 1500 ppm KNap at 22 and 32 DAE
T_5 = foliar application of 2 ppm mixtalol at 22 DAE
T_6 = foliar application of 2 ppm mixtalol at 22 and 32 DAE

One thousand and 1500 ppm KNap were prepared according to Fattah (1969) and mixtalol were collected from Lever Brothers, Bangladesh Ltd. The experiment was laid out in a randomized complete block design. The unit plot size was 4 X 6 m^2. Seeds were sown on 1.11.98 and 4.11.99. Intercultural operations and plant protection measures were done as per recommendations. Chlorophyll a, b and carotenoid content of leaves from 5th and 9th nodes were determind at 35 and 65 DAE respectively. The analysis of the leaf pigments were determined spectrophotometrically. The optical density (OD) for each solution was measured at 663, 645 and 440.5 mμ against 80% acetone as blank in one cm cell. The amount of chlorophyll a and b were determined by using specific absorption co-efficient of McKinney (1940) and the following formula of Maclachalam and Zalik (1963):

$$C_a = \frac{(12.3 \times D\ 663 - 0.86 \times D\ 645)V}{d \times 1000 \times W}\ \text{mg g}^{-1}\ \text{of fresh leaf}$$

$$C_b = \frac{(19.3 \times D\ 645 - 3.6 \times D\ 663)V}{d \times 1000 \times W}\ \text{mg g}^{-1}\ \text{of fresh leaf}$$

Where, C_a = chlorophyll a, C_b = chlorophyll b
D = optical density (OD) at wave length indicated
V = final volume, W = fresh weight of leaf materials used
d = length of light path in cm

Corresponding Author: Ferdousi Begum, Scientific Officer, Oilseed Research Centre, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh

The amount of carotenoids were determined by the following equation of Von Wettstein (1957):

$$C_c = 4.695 \times D\ 440.5\text{-}0.268C\ (a+b)$$

Where, C_c = Concentration of carotenoids in mg L^{-1}.

The carotenoid content was then converted into mg g^{-1} fresh leaves. Collected data were statistically analyzed and treatment means were compared by least significant difference (Steel and Torrie, 1960).

Results and Discussion

Chlorophyll a: At 35 DAE, chlorophyll a content of leaves was influenced both significantly and nonsignificantly following different treatments in both the years. In 1998-99, the highest chlorophyll a content, 0.687 mg g^{-1} of fresh leaf was due to double spray of 1000 KNap (T_2) and it was statistically identical to T_1 and T_3 (Table 1). In 1999-00, the highest chlorophyll a content of 0.985 mg g^{-1} was recorded from T_6 and it was identical to T_5 and significantly different from all other treatments. At 65 DAE, chlorophyll a content of leaves significantly varied in the first year but not in the second year. In 1998-99 the highest was recorded from 2 ppm mixtalol treatment at 22 and 32 DAE (T_6) and it was statistically identical to T_5, T_2 and T_1. In 1999-00, variations of chlorophyll a content were not significant among the treatments, but the highest amount was recorded from T_1 and it was followed by T_2, T_6 and T_3. In case of rice, Fattah and Pasha (1978) also reported increased chlorophyll a content following KNap treatment as foliar spray or seed soaking. In case of sweet potato, Hossain and Fattah (1987) observed that chlorophyll a content increased significantly at 30, 60, 90 and 120 days old plants following application of 1000 and 2500 ppm KNap.

Chlorophyll b: At 35 DAE significant and nonsignificant variation of chlorophyll b was observed among the treatments in both the years. In 1998-99, the chlorophyll b content, ranged from 0.5232 to 0.6014 mg g^{-1} of fresh leaf (Table 2). The highest chlorophyll b content, 0.6014 mg g^{-1} was recorded from the plants with 2 ppm mixtalol at 22 and 32 DAE (T_6) and it was statistically identical to T_5, T_2 and T_3. In 1999-00, at 35 DAE, the highest chlorophyll b content, 0.7454 mg g^{-1} was recorded from T_5 and it was statistically identical to T_6 and significantly different from the remaining treatments including control. At 65 DAE, chlorophyll b content of leaves varied both significantly and non significantly among the plants of various treatments in 1998-99 but in 1999-00 variations were not significant. In 1998-99, the highest chlorophyll b content (0.7898 mg g^{-1}) was recorded from leaves of the plants receiving T_6 and it was significantly higher than those of the other treatments. The second highest was recorded from T_5 and it was followed by T_1, T_3 and T_2. In the second year chlorophyll b content ranged from 0.6211 to 0.6702 mg g^{-1} and the variations following different treatments were not significant. At 35 DAE, the mean results for two years showed that increase/decrease of chlorophyll b content over the control plant values were 3.95, 3.09, 0.34, -0.69, 15.12 and 14.60% following T_1, T_2, T_3, T_4, T_5 and T_6 treatments respectively (Table 2).

Table 1: Influence of KNap and mixtalol on chlorophyll a content of rapeseed (*B. campestris* L. var. Dhali) leaf at two different ages of plant during 1998-99 and 1999-00 seasons

	At 35 days after emergence mg g^{-1} fresh weight of leaf			At 65 days after emergence gm g^{-1} fresh weight of leaf		
Treatments	1998-99	1999-00	Mean	1998-99	1999-00	Mean
T_0	0.613d	0.703d	0.658	0.768d	0.903	0.835
T_1	0.664ab	0.770c	0.717	0.885a	0.949	0.917
T_2	0.687a	0.898b	0.792	0.886a	0.937	0.912
T_3	0.659a-c	0.704d	0.681	0.842b	0.924	0.883
T_4	0.597e	0.776c	0.687	0.834b	0.916	0.875
T_5	0.634b-d	0.963a	0.798	0.886a	0.923	0.905
T_6	0.652bc	0.985a	0.818	0.899a	0.935	0.917
LSD (0.05)	0.034	0.058	-	0.021	NS	-
CV%	3.51	4.68	-	1.61	2.69	-

Table 2: Influence of KNap and mixtalol on chlorophyll b content of rapeseed (*B. campestris* L. var. Dhali) leaf at two different ages of plant during 1998-99 and 1999-00 seasons

	At 35 days after emergence mg g^{-1} fresh weight of leaf				At 65 days after emergence gm g^{-1} fresh weight of leaf			
Treatments	1998-99	1999-00	Mean	% increased over control	1998-99	1999-00	Mean	% increased over control
T_0	0.523d	0.640b	0.582	-	0.711c	0.621	0.666	-
T_1	0.570bc	0.640b	0.605	3.95	0.740c	0.627	0.669	4.95
T_2	0.591ab	0.608b	0.600	3.09	0.729d	0.624	0.675	1.35
T_3	0.583ab	0.585b	0.584	0.34	0.738c	0.634	0.686	3.00
T_4	0.547cd	0.609b	0.578	-0.69	0.709f	0.669	0.689	3.45
T_5	0.594a	0.745a	0.670	15.12	0.770b	0.670	0.720	8.11
T_6	0.601a	0.733a	0.667	14.60	0.790a	0.666	0.728	9.31
LSD (0.05)	0.026	0.076	-	-	0.005	NS	-	-
CV%	3.10	7.89	-	-	0.46	2.60	-	-

Table 3: Influence of KNap and mixtalol on carotenoid content of rapeseed (*B. campestris* L. var. Dhali) leaf at two different ages of plant during 1998-99 and 1999-00 seasons

	At 35 days after emergence mg g^{-1} fresh weight of leaf				At 65 days after emergence gm g^{-1} fresh weight of leaf			
Treatments	1998-99	1999-00	Mean	% increased over control	1998-99	1999-00	Mean	% increased over control
T_0	5.187d	5.152d	5.170	-	5.190d	5.222	5.208	-
T_1	5.938bc	5.913bc	5.926	14.62	5.621b	5.626	5.624	7.99
T_2	5.597cd	5.591cd	5.578	7.89	5.826a	4.840	5.833	12.0
T_3	5.373d	5.382cd	5.776	11.72	5.515c	5.357	5.354	2.80
T_4	6.588a	5.751d	5.832	12.80	5.508b	5.397	5.452	4.69
T_5	6.410ab	6.303ab	6.356	22.94	5.284cd	5.301	5.292	1.61
T_6	6.684a	6.582a	6.633	28.30	5.284cd	5.299	5.292	1.61
LSD (0.05)	0.527	0.554	-	-	0.115	NS	-	-
CV%	5.67	6.22	-	-	1.47	7.46	-	-

The value with different letters are dissimilar at $P < 0.05$, NS = Non significant

At 65 DAE the mean results for two years showed 4.95, 1.35, 3.00, 3.45, 8.11 and 9.31% higher over the control following T_1, T_2, T_3, T_4, T_5 and T_6 treatments respectively (Table 2). Mahtab (1997) reported that chlorophyll a, b and carotenoid content of okra leaves of 50, 65 and 81 days old plants were highest in plants treated with 2.5 ppm mixtalol. In case of lady's finger, Jahan *et al*. (1991) found that chlorophyll a and b contents increased significantly due to 1000 ppm KNap application. Hoque (1980) in mustard reported that chlorophyll contents were decreased at initial stages but increase at later stages of plants following KNap application. The chlorophyll content in the leaves of tomato, paddy and wheat appreciably increased when 1 ppm mixtalol was applied as seed soaking for 24 h (Thind, 1986). Vinkatramani *et al*. (1987) reported that chlorophyll contents of paddy, maize and tomato were increased by 26.9, 7.4 and 14.6% respectively due to the application of 2 ppm mixtalol as foliar spray. Tanzeen (1997) reported on sunflower that the highest chlorophyll a and b content at 55 and 65 days old plants were obtained from the leaves treated with 2 ppm mixtalol.

Carotenoids: Carotenoid content of rapeseed leaf varied significantly and nonsignificantly at 35 days after emergence in both the years. In 1998-99, the highest carotenoid content of 6.684 mg g^{-1} of leaf was recorded from T_6 and it was statistically identical to T_4 and T_5. In 1999-00, the highest carotenoid content of 6.582 mg g^{-1} of leaf was recorded from T_6 and it was statistically identical to T_5 and significantly different from all other treatments (Table 3). Carotenoid content of leaf increased by 28.30, 22.94, 12.80, 11.72, 7.89 and 14.62% over control following T_6, T_5, T_4, T_3, T_2 and T_1 respectively.

At 65 days after emergence carotenoid content was significantly affected by different treatments in 1998-99 but not in 1999-00. In 1998-99, the highest carotenoid content of 5.826 mg g^{-1} of fresh leaf was obtained following double spray of 1000 KNap (T_2). In 1999-00, carotenoid contents of leaves did not vary significantly. Mean results for two years showed that increase of carotenoid contents over the control plant values were 7.99, 12.00, 2.80, 4.62, 1.61 and 1.61 following T_1, T_2, T_3, T_4, T_5 and T_6 treatments respectively. Very few literature is available in this respect, however, Tanzeen (1997) reported that carotenoid content of sunflower leaf was increased following mixtalol treatments.

From the results it may be concluded that 1000 ppm KNap and 2 ppm mixtalol may be sprayed at vegetative stage of rapeseed plant for increased chlorophyll a, b and carotenoid contents of leaf.

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