Bangladesh J. Sci. Ind. Res. **42**(3), 353-356 2007 **Short communication**

Stomatal Frequency and Distribution in Mustard (*Brassica juncea* L.) in Relation to Soil Moisture

N.K. Paul and R.K. Mondal

Department of Botany, Rajshahi University, Rajshahi, Bangladesh

Abstract

Effect of soil moisture on stomatal frequency and distribution of mustard was studied. The irrigated plants had significantly higher number of stomata on both the adaxial and abaxial surfaces of leaf than the rainfed plants. No significant effect of soil moisture on stomatal frequency of stem and pod was found.

Key words : Mustard, soil moisture, stomatal frequency, pod.

Introduction

Stomata affect the intensity of water vapour and gas exchanges between the plant and atmosphere, thereby constituting an efficient control mechanism of water loss, mainly when plants experience water stress Ciha and Brun 1975; Sapra *et al.*, (1975). Allen *et al.*, (1971) concluded that pods of rape produce assimilate for their own development and for the seeds they contain and the contribution of assimilate of leaves to seed growth is minor and indirect. Freyman *et al.* (1973), however, found that photosynthates were translocated from the leaves of *Brassica campestris* to the pods. Hozyo *et al.* (1972) observed that rape pods appeared to assimilate substantial amount of atmospheric CO_2. Major (1975) measured the frequency of stomata on the main stuctures of the rape plants and concluded that all tissue types of the plant can assimilate CO_2.

This experiment was undertaken to determine the effect of irrigation on stomatal frequency and distribution in the epidermis of the main structures of the mustard plant.

Materials and Methods

Two cultivars (Sambal and Daulat) of mustard (*Brassica juncea* L.) were selected as plant materials. The experiment was conducted in the Botanical Reasearch Garden of Rajshahi University. There were two treatments irrigated (10 mm irrigation was given at 10 days interval throughout the growing season) and rainfed (no irrigation was given). At the pod-filling stage and at maturity, stomata on leaf, stem and pod at different positions were studied. Stomata were counted by applying quickfix (Wembley Enterprises, India) on the segments of leaf, stem and pod. In case of leaf, stomata at the

middle and margin positions were counted only at the pod-filling stage. Stomata of stem were counted at one position at the pod-filling stage and three positions at maturity. Stomata at pod wall, pedicel and pod beak were counted at both the stages. The number of stomata of five random focuses was counted under a compound microscope with 15X40 magnification and subsequently converted to the number per mm^2 of area. The experimental design split plot and statistical analysis was done accordingly. The irrigation treatments as main plots, cultivars as sub plots and positions were considered as sub-sub plots.

Results and Discussion

Stomatal frequency on leaf at the central and the marginal positions at both the adaxial and abaxial surfaces are presented in Table I. Both the adaxial and abaxial surfaces had significantly lower stomatal frequency in the irrigated plants than that of the rainfed plants. Cole and Dobrenz (1970) reported that moisture stress increased stomatal frequency in alfalfa. Van de and Fuller (1935) stated that plants had a lower stomatal frequency under optimal moisture conditions than that under stress conditions. They found that ordinary epidermal cells were larger under optimal conditions resulting in greater distances between stomata and a lower stomatal frequency.

There were no significant differences of stomatal frequency between the central and marginal positions of leaf though it was slightly higher in the marginal position

Table I. Stomatal frequency (number of stomata mm^{-2}) on leaves at different positions as influenced by soil moisture

Treatment	Centre	Sambal Margin	Mean	Centre	Daulat Margin	Mean	Mean
			Adaxial surface				
Irrigated	156	169	163	208	177	193	178
Rainfed	260	302	281	279	322	301	291
Mean	208	236		244	250		
LSD 5%	(a) 90	(b) NS	(c) NS				
			Abaxial surface				
Irrigated	256	297	277	271	366	319	298
Rainfed	430	493	462	422	416	419	440
Mean	343	395			347	391	
LSD 5%	(a) 108	(b) NS	(c) NS				

LSD (a) for difference between treatment means for the same or different positions, (b) for difference between cultivar means for the same or different treatment means and (c) for difference between position means and NS = Non significant for all tables

(Table I). Stomatal frequency was higher on the abaxial surface than that of the adaxial surface of the leaf (Table I) Nerkar, *et al*, (1981) also observed similar results in field beans and in soybean.

Stomatal frequency on stem at the pod-filling stage (Table II) indicated that soil moisture had no significant effect. Stomatal frequency

Table II. Stomatal frequency (number of stomata mm^{-2}) on stem of two mustard cultivars at the pod-filling stage.

Treatment	Sambal	Daulat	Mean
Irrigated	35	40	38
Rainfed	21	31	26
Mean	28	36	
LSD 5 %	(a) NS	(b) NS	

on stem at maturity at different positions (Table III) exhibited that the irrigated plants of Sambal had significantly higher stomatal frequency on stem. Significantly highest stomatal frequency was found on the tip of the stem, whereas significantly lowest at the base in both the cultivars.

Stomatal frequency on pod at different positions at the pod-filling stage and at maturity are given in Table IV. No significant effect of soil moisture on stomatal frequency on pod was found at any stage. At maturity, stomatal frequency of Sambal was significantly lowest on pedicel than that of the pod wall and beak. Significantly highest stomatal frequency was observed on pod beak at maturity stage.

The overall results indicated that stomata were present on leaf, stem, pod wall, pedicel and beak. Leaf had the highest stomatal frequency and stems the lowest and the ranking of the pod was second. This suggests that there is potential for assimilation of atmospheric CO_2 in pods, pedicels, beaks, stem and leaves of mustard plants. Both the adaxial and abaxial surfaces of leaf had significantly lower stomatal frequency in the irrigated plants than that of the rainfed plants. But soil moisture had no significant effect on stomatal frequency of both stem and pod.

Table III. Stomatal frequency (number of stomata mm^{-2}) on different positions of stem at maturity as influenced by soil moisture

Treament	Base	Sambal centre	Tip	Mean	Base	Daulat Centre	Tip	Mean	Mean
Irrigated	15	38	75	43	12	35	56	34	39
Rainfed	8	25	75	36	10	29	58	32	34
Mean	12	32	75		11	32	57		
LSD 5 %	(a) 6	(b) NS	(c) 10						

Table IV. Stomatal frequency (number of stomata mm^{-2}) on different positions of pod at pod-filling and maturity stages

Treament	Pod wall	Sambal pedicel	Pod beak	Mean	Pod wall	Daulat pedicel	Pod beak	Mean	Mean
				Pod-filling stage					
Irrigated	79	84	77	80	59	58	73	63	72
Rainfed	60	50	79	63	54	61	62	59	61
Mean	70	67	78		57	60	68		
LSD 5 %	(a) NS	(b) NS	(c) NS						
				Maturity stage					
Irrigated	66	54	70	63	54	56	88	66	65
Rainfed	67	39	60	55	58	67	67	64	60
Mean	67	47	65		56	62	78		
LSD 5 %	(a) NS	(b) NS	(c) 11						

References

Allen, E.J. Morgan, D.G. and Ridgman, W.J. (1971) A physiological analysis of the growth of oilseed rape. *J. Agric. Sci. Camb.* **77 :** 339-341.

Ciha, A.J. and Brun, W.A. (1975) Stomatal size and frequency in soybeans. *Crop Sci.* **15 :** 309-313.

Cole, D.F. and Dobrenz, A.K. (1970) Stomatal density of alphalpha (*Medicago sativa* L.). *Crop Sci.* **10** : 61-63.

Freyman, S. Charnetski, W. A. and Crookston, R. K. (1973) Role of leaves in the formation of seed in rape. *Can. J. Plant Sci*. **53** : 693-694.

Hozyo, Y. Kato S. and Kobayashi, H. (1972) Photosynthetic activity of the pods of rape plants (*Brassica napus* L.) and the contribu tion of the pods to the ripening of rape seeds. Proc. *Crop Sci. Soc. Japan.* **41** : 420-425.

Major, D.J. (1975) Stomatal frequency and distribution in rape. *Can. J. Plant Sci.* **55** : 1077-1078.

Nerkar, Y. S. Wilson, D. and Lawes, D. A. (1981) Genetic variation in stomatal characteristics and behaviour, water use and growth of five *Vicia faba* L. genotypes under contrasting moisture regimes. *Euphytica.* **30** : 335-345.

Sapra, V. T. Hughes, J. L. and Sharma, G. C. (1975) Frequency, size and distribution of stomata in triticale leaves. *Crop Sci.* **15** : 356-358.

Van de R. E. and Fuller, G. D. (1935) Environmental effects on stomatal characteristics of some plant species. *Ecology.* **16** : 278-279.

Received : August 28, 2006;
Accepted : May 29, 2007