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Effect of energy requirement on growth and development of mustard [*Brassica juncea* (L.)] cultivars at different phenological stages

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Abstract
A field experiment was conducted during *Rabi season* of 2014 on the topic entitled “Effect of energy requirement on growth and development of mustard [*Brassica juncea* (L.)] cultivars at different Phenological stages” in sandy loam soil of N.D. University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). The experimental comprised of three planting geometry *viz*., 40×15cm, 40×20cm, 40×25cm and three varieties *viz*., Varuna, Vardan and NDR-8501. Highest Thermal use efficiency was recorded when sowing was done on 40×15cm planting geometry, followed by sowing done on 40×20cm. NDR-8501 variety was found more conducive for growth development, grain yield and thermal use efficiency. Thermal unit (1659.4^{0}days), Photo thermal index (129.64), from sowing to maturity produced the high yield of Indian mustard.

Keywords: GDD, TUE, APAR, RUE, PTI

Introduction
Indian mustard (*Brassica juncea* L.) is an important oilseed crop belong to family cruciferae. The oilseed crop play an important role in agriculture economy of India. Our country is the largest oil economy in the world after the U.S., China and Brazil in term of vegetable oil. India occupies the second position in area after China and third position in production in the world after China and Canada. In India, during year 2012-2013, the area of Rapeseed-mustard was 67.17 lakh ha. With the production of 72.62 lakh mt. and productivity of 10.81 quintal/ha. In U.P during the year 2013-14 the area of rapeseed-mustard was 6.5 lakh ha. With the production of 7.8 lakh mt. and productivity of 12.08 quintal/ha (Anonymous, 2013-14) [1]. An option of suitable crop management practices are important factors for improving crop productivity. Sowing time has profound effect on growth and yield of mustard (Pawar *et al.*, 1976) [8]. Sowing dates and crop geometry are the two foremost non-monetary inputs of production can be manipulated to increase the crop productivity. Since information on sowing dates and crop geometry of Indian mustard. Climate change has increased the intensity of heat stress and heat stress due to increased temperature is an agricultural problem in many areas in the world as well as in India (Beck *et al*., 2007) [2]. Transitory or constantly high temperatures cause an array of morphological, physiological and biochemical changes in plants (Serraj *et al*., 1999, Moradshahi *et al*., 2004) [9, 7].

Materials and Methods
The present investigation entitled “Effect of energy requirement on growth and development of mustard [*Brassica juncea* (L.)] cultivars at different Phenological stages” was conducted at Instructional Farm of Narendra Deva University of Agriculture and Technology Kumarganj, Faizabad (U.P.) during *Rabi* season of 2014. The farm is located 42 Km away from Faizabad city on Faizabad- Raebareily road at 26˚47 N latitude and 82˚12 E longitude and about 113 meters above the mean sea level. The experiment was conducted in Randomized Block Design (RBD). The different growth parameters studied were measured as Heat unit/ Thermal unit (GDD), Thermal use efficiency (g/m^{-2}/^{0}days), APAR (MJ/m^2), Radiation use efficiency (g/MJ), Photo thermal Index.

Results
Heat unit/ Thermal unit (GDD) of Indian mustard at different Phenophases as affected by planting geometry and varieties have been presented in Table-1. The maximum heat Unit (GDD) requirement from sowing to maturity were recorded 1890.8 ^{0}C days at planting

geometry (40×15cm.) while minimum accumulated growing degree days from sowing to maturity1436.0^{0}C days was observed under planting geometry (40×25cm) Wider planting geometry recorded minimum GDD requirement at all the stages. Different varieties had marked influence on the Thermal unit/ Heat unit/growing degree days of Indian mustard at all the phenophases. Accu. GDD ranged from 1434.3^{0}days to 1659.4^{0}Cdays irrespective of different varieties. Maximum Thermal unit/G.D.D/heat Unit requirement from sowing to maturity 1685^0 days were obtained in Vardan variety, while minimum thermal unit was obtained in Varuna Variety (1434.3^{0}C days) from sowing to maturity of Indian mustard. The results are corroborated with Singh *et al.* (2014) [12], Hundal *et al.* (2003) [4], Srivastava *et al.* (2011) [13], Goyal *et al.* (2006) [3].

Thermal use efficiency (g/m^{-2}/^{0}days) requirement of Indian mustard at different Phenophases as affected by planting geometry and varieties have been presented in Table-2. The maximum Thermal use efficiency requirement from sowing to maturity were recorded 0.67 at planting geometry (40×15cm.) while minimum Thermal use efficiency from sowing to maturity 0.56 was observed under planting geometry (40×25cm.). Similar results are reported by Khushu *et al.* (2001) [6]. Wider planting geometry recorded minimum thermal use efficiency requirement at all the stages. Different varieties had marked influence on the thermal use efficiency of Indian mustard at all the phenophases. Thermal use efficiency ranged from 0.53 to 0.67 irrespective of different varieties. Maximum thermal use efficiency (0.67) requirement from sowing to maturity were obtained in NDR-8501 variety while minimum thermal use efficiency was obtained in Varuna Variety (0.53) from sowing to maturity of Indian mustard. Similar results are reported by Singh *et al.* (2014) [12], Hundal *et al.* (2003) [4], Srivastava *et al.* (2011) [13].

Cumulative APAR (MJ/m^2) requirement of Indian mustard at different Phenophases as affected by planting geometry and varieties have been presented in Table-3. The maximum Cumulative APAR requirement from sowing to maturity were recorded (578 MJ/m^2) at planting geometry (40×15cm.) while minimum Cumulative APAR from sowing to maturity (466 MJ/m^2) was observed under planting geometry (40×20cm). Different varieties had marked influence on the Cumulative APAR (MJ/m^2) of Indian mustard at all the phenophases. Cumulative APAR ranged from 483 to 532 MJ/m^2 irrespective of different varieties. Maximum Cumulative APAR (532 MJ/m^2) requirement from sowing to maturity were obtained in NDR-8501 variety while minimum Cumulative APAR was obtained in Varuna Variety (483 MJ/m^2) from sowing to maturity of Indian mustard. Similar results are reported by Singh *et al.* (2006) [11], Khichar *et. al.* (2000) [5].

Radiation use efficiency (g/MJ) as affected by planting geometry and varieties are given in Table-4. Indian mustard sown on 40×20cm recorded higher Radiation use efficiency during all the stages followed by 40×15cm sowing and lowest Radiation use efficiency was recorded in 40×25cm sown of mustard. Different varieties had significant variation on Radiation use efficiency (RUE) as given in Table-4.3.4. Higher radiation use efficiency was recorded under Varuna followed by NDR-8501 at all the stages of Indian mustard while the lowest RUE was recorded in Vardan variety. Similar results are reported by Singh *et al.* (2006) [11], Khichar *et al.* (2000) [5].

Photo thermal Index of Indian mustard at different Phenophases as affected by planting geometry and varieties have been presented in Table-5. The maximum Photo thermal Index from sowing to maturity were recorded 131.31 at planting geometry (40×15cm.) while minimum Photo thermal Index (122.74) from sowing to maturity was observed under planting geometry (40×25cm.). Wider planting geometry recorded minimum Photo thermal Index at all the stages. Different varieties had marked influence on the Photo thermal Index of Indian mustard at all the phenophases. Photo thermal Index ranged from 107.04 to 127.66 irrespective of different varieties. Maximum Photo thermal Index (129.64) from sowing to maturity were obtained in NDR-8501 variety while minimum Photo thermal Index (107.04) was obtained in Varuna Variety from sowing to maturity of Indian mustard. The results are corroborated with Singh *et al.* (2014) [12], Hundal *et al.* (2003) [4].

Table 1: Thermal unit at different phenophases (˚C days) of Indian mustard as affected by planting geometry and varieties.

Treatments	Phenophases					
	Emergence	**Four Leaf Stage**	**Flower Initiation**	**Siliquae Initiation**	**Pod Development**	**Maturity**
Planting geometry						
40×15 cm	93.4	385.3	574.7	888.7	1232.3	1890.8
40×20 cm	88.7	373.1	573.2	888.5	1254.9	1451.9
40×25 cm	91.0	392.6	573.1	889.1	1263.1	1436.0
Varieties						
Varuna	89.9	393.9	577.2	886.1	1239.1	1434.3
Vardan	92.2	376.3	566.5	885.8	1264.4	1685.0
NDR-8501	91.0	380.7	577.4	894.2	1246.8	1659.4

Table 2: Thermal use efficiency (g/m^{-2}/^{0}days) of Indian mustard as affected by planting geometry and varieties.

Treatments	Thermal use efficiency (g/m^{-2}/^{0}days)						
	30 DAS	**45 DAS**	**60 DAS**	**75 DAS**	**90 DAS**	**105 DAS**	**At harvest**
Planting geometry							
40×15 cm	0.13	0.18	0.22	0.43	0.55	0.63	0.67
40×20 cm	0.11	0.16	0.20	0.37	0.50	0.54	0.60
40×25 cm	0.11	0.15	0.19	0.36	0.47	0.59	0.56
Varieties							
Varuna	0.12	0.16	0.21	0.40	0.52	0.56	0.62
Vardan	0.10	0.14	0.18	0.34	0.44	0.48	0.53
NDR- 8501	0.13	0.18	0.22	0.43	0.56	0.60	0.67

Table 3: Cumulative APAR (MJ/m^2) of Indian mustard as affected by planting geometry and varieties.

Treatments	Cumulative APAR(MJ/m^2)						
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At harvest
Planting geometry							
40×15 cm	88.1	177	272	369	471	566	578
40×20 cm	75	150	238	325	403	462	466
40×25 cm	86	172	266	366	466	519	538
Varieties							
Varuna	79	141	228	320	418	479	483
Vardan	78	143	233	322	427	492	486
NDR-8501	83	146	235	327	461	519	532

Table 4: Radiation use efficiency (g/MJ) of Indian mustard as affected by planting geometry and varieties.

Treatments	Radiation use efficiency (g/MJ)						
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At harvest
Planting geometry							
40×15 cm	0.59	0.57	0.57	0.93	1.13	1.25	1.52
40×20 cm	0.63	0.60	0.59	0.93	1.18	1.37	1.69
40×25 cm	0.51	0.49	0.49	0.79	0.96	1.34	1.37
Varieties							
Varuna	0.62	0.67	0.64	1.01	1.19	1.38	1.69
Vardan	0.54	0.56	0.53	0.86	0.99	1.15	1.44
NDR-8501	0.63	0.69	0.66	1.06	1.16	1.37	1.65

Table 5: Photo Thermal Index at different phenophases of Indian mustard as affected by planting geometry and varieties.

Treatments	Photo Thermal Index					
	Sowing to Emergence	Emergence to Four Leaf Stage	Four Leaf Stage to Flower Initiation	Flower Initiation to Siliquae Initiation	Siliquae Initiation to Pod Development	Pod Development to Maturity
Planting geometry						
40×15 cm	14.83	17.51	34.42	22.79	41.63	131.31
40×20 cm	14.79	17.52	32.76	22.67	40.10	109.17
40×25 cm	14.69	17.45	33.71	23.21	39.47	122.74
Varieties						
Varuna	14.51	17.43	35.19	23.08	40.63	107.04
Vardan	14.88	17.67	32.37	22.95	39.03	127.66
NDR- 8501	14.69	17.55	33.18	22.70	41.56	129.64

Conclusion

It is concluded that present study in Higher radiation use efficiency was recorded under Varuna followed by NDR-8501 at all the stages of Indian mustard. Maximum Photo thermal Index (129.64) from sowing to maturity were obtained in NDR-8501 variety while minimum Photo thermal Index (107.04) was obtained in Varuna Variety from sowing to maturity of Indian mustard. Highest net return per rupee invested was recorded (2.40) with 40×15 cm planting geometry and NDR-8501 variety.

References

1. Anonymoys. Directorate of economics and statistics, Department of Agriculture and cooperation (DAC), 2013-14. www.Indiabudget.nic.in_es2013-14 _echap-08 pdf Economic survey, 138.
2. Beck EH, Fettig S, Knake C, Hartig K, Bhattarai T. Specific and unspecific responses of plants to cold and drought stress. Journal of Biosciences. 2007; 32:501-510.
3. Goyal KS, Das Singh B, Mohanty RAK. Influence of the thermal environment on phenology, growth and development of mustard varieties. Journal of Soils and Crops. 2006; 16(2):283-290.
4. Hundal SS, Kaur P, Malikpuri SDS. Agroclimatic models for prediction of growth and yield of Indian mustard (Brassica juncea). Indian Journal of Agricultural Sciences. 2003; 73(3):142-144.
5. Khichar ML, Yadav YC, Bishnoi OP, Ram Niwas. Radiation use efficiency of mustard as influenced by sowing dates, plant spacingand cultivars. Journal of Agrometeorology. 2000; 2(1):97-99.
6. Khushu MK, Jamwal JS, Raina AK. Heat unit efficiency in Indian mustard (*Brassica juncea* L.). Cruciferae Newsletter. 2001; (23):37-38.
7. Moradshahi A, Eskandari BS, Kholdebarin B. Some physiological responses of canola (*Brassica napus* L.). Iranian Journal of Sccience and Technology. 2004; 28:43-50.
8. Parwar KR, Giri AN, Katter KD, Nadre KR, Caushal CH. Effect of sowing dates on yield of promising Varieties of cotton under irrigated conditions in Marathwada region. Journal of Maharashtra Agricultural Universities. 1976; 1(1):75-77
9. Serraj R, Sinclair TR, Purcell LC. Symbiotic N2 fixation response to drought. Journal of Experimental Botany 1999; 50:143-155.
10. Singh R, Rao VUM, Singh D. Effect of sowing time and planting density on radiation use efficiency of Indian brassica. Journal of Phytological Research. 2006; 19(2):319-322.
11. Singh T, Dahiya KS, Sidhu MS. Effect of genotype, seedling age and row spacing on performance of transplanted African mustard (*Brassica carinata*) under late-sown conditions. Indian J Agron. 2006; 51(3):221-224.
12. Singh MP, Singh NB. Effect of energy requirement parameter such as GDD, PTU, PTI, HTU, HUE on growth and development of Indian mustard at different

Phenological stages under late sown condition. Indian Journal of Plant Physiology. 2014; 19(3):238-243.
13. Srivastava AK, Adak R, Chakravarty NVK. Quantification of growth and yield of oilseed (*Burasica* using thermal indices under semi-aid environment. Journal of Agro-meteorology. 2011; 13(2):135-140.