

Influence of Temperature on Rapeseed-Mustard Yield at Selected Locations in Chhattisgarh State

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ABSTRACT

Mustard is the second most important edible oilseed crop in India after groundnut and accounts for nearly 30 percent of the total oilseeds produced in the country. Weather parameters play major role in determining the crop growth, development and yield because weather strongly influences the physical expression of genetic potential of the crop. The present investigation aimed to find out relationship between maximum and minimum temperature during different stages of mustard crop and yield at three locations of Chhattisgarh state indicated that at Raipur maximum temperature during vegetative stage showed significant negative relation whereas at Jagdalpur significant positive relation was found. Maximum and minimum temperature at any crop growth stage did not have relation with yield at Ambikapur. At the same time, minimum temperature during reproductive stage of crop showed negative relation with mustard yield in all three locations though it was not significant one.

Key words: Temperature, Mustard yield, Correlation, Agro-climatic zone

INTRODUCTION

India is one of the largest Rapeseed-Mustard growing countries in the world, occupying the first position in area and second position in production after China. It is the second most important edible oilseed crop in India after groundnut and accounts for nearly 30 percent of the total oilseeds produced in the country. Weather parameters play major role in determining the crop growth, development and yield because weather strongly influences the physical expression of genetic potential of the crop. Any significant deviation of this parameter from the optimum value became detrimental for the crop productivity. Generally about 67 per cent variation of any crop is governed by prevailing weather condition and 33 per cent by other crop management factors. Weather has direct effect on growth and development of plants. All the physio-chemical and biological activities of the plants are governed by the weather variables prevailing in that area. Keeping the above facts in mind, the present study aimed at to

find effect of maximum and minimum temperatures at different growth stages on yield of mustard in three locations i.e. Raipur, Ambikapur and Jagdalpur of Chhattisgarh state which is representing the three agro-climatic zones viz. Chhattisgarh Plain Zone, Northern Hills and Bastar Plateau, respectively.

MATERIAL AND METHODS

The long term data on maximum and minimum temperature collected from the Department of Agrometeorology, IGKV, Raipur for three stations (Raipur – 38 years; Jagdalpur – 29 years and Ambikapur (18 years) has been compiled. For assessing the influence of temperature both maximum and minimum temperatures, the relationship between these parameters at four main growth stages viz., seedling, vegetative, reproductive and maturity stage was established with rapeseed-mustard yield. The average maximum and minimum temperatures at four growth stages were obtained by averaging the daily maximum and minimum temperatures for each

growth stage. The duration of each growth stage of rapeseed-mustard crop was considered as follows.

Stage of the crop	Duration
Seedling	2 weeks
Vegetative	3 weeks
Reproductive	6 weeks
Maturity	4 weeks

In order to find out the relationship between maximum and minimum temperature of different crop growth stages and rapeseed-mustard yield, correlation analysis was carried out by using following formula.

$$r(X, Y) = \frac{\text{Cov}(X, Y)}{\sigma_x \sigma_y}$$

Where,

r = Correlation coefficient

Cov (X, Y) = Co-variance of variable X and Y

σ_x = Standard deviation of variable x

σ_y = Standard deviation of variable y

RESULTS AND DISCUSSION

Raipur

The relationship between temperatures (maximum and minimum) at different growth stages viz. seedling, vegetative, reproductive and maturity with rapeseed-mustard yield at Raipur is shown in table 1. It can be seen that there is a significant negative relationship between maximum temperature during seedling stage and rapeseed-mustard yield while, other phenological stages did not show any significant relationship.

Table. 2: Correlation coefficients between temperatures (Maximum and Minimum) and yield of rapeseed-mustard at different growth stages at Jagadapur

Growth stages	Maximum temp	Minimum temp
Seedling	0.460**	0.333
Vegetative	0.517 **	0.162
Reproductive	0.150	-0.084
Maturity	0.372*	0.043

(**significant at 1% level; *significant at 5% level)

In Raipur district rapeseed-mustard is grown under rainfed conditions. Though the winter conditions in Raipur district is better for rapeseed-mustard cultivation point of view still the winter span is less and the temperature fluctuations limit the rapeseed-mustard crop growth and productivity. The correlation analysis showed that there is a significant positive relationship between minimum temperature during vegetative stage and yield of mustard. In other way, increase in night time temperature would lead to more vegetative growth in mustard crop. At the same time, minimum temperature during reproductive period of crop influenced the yield negatively though it was not significant. The temperatures during reproductive stage are more crucial for rapeseed-mustard crop and it was found that the rapeseed-mustard yields decrease when the minimum temperature goes < 14°C. Such relationship if carried out with other techniques can help in determining the cardinal temperatures of rapeseed-mustard crop under Raipur conditions. Singh *et al.* (2002) opined that the significant positive

Table. 1: Correlation coefficients between temperatures (Maximum and Minimum) and yield of rapeseed-mustard at different growth stages at Raipur

Growth stages	Maximum temp	Minimum temp
Seedling	-0.350*	0.225
Vegetative	-0.119	0.391*
Reproductive	-0.233	-0.280
Maturity	0.144	-0.044

(mmsignificant at 1% level; msignificant at 5%

Table. 3: Correlation coefficients between temperatures (Maximum and Minimum) and yield of rapeseed-mustard at different growth stages at Ambikapur

Growth stages	Maximum temp	Minimum temp
Seedling	-0.237	0.152
Vegetative	0.018	-0.357
Reproductive	-0.028	-0.160
Maturity	-0.023	0.022

(**significant at 1% level; *significant at 5% level)

association of maximum and minimum temperature during vegetative phase indicates that temperatures prevailed during vegetative phase were within the cardinal limits of temperatures required by the crop. Hence, the higher temperatures during vegetative phase resulted in higher photosynthetic activity leading to better plant growth and development, which ultimately got translated, into higher seed yield because of favorable yield attributes.

Jagdalpur

The relationship between temperatures (maximum and minimum) at different growth stages of rapeseed-mustard and its yield at Jagdalpur district is shown in table 2. It can be seen from the table that there exists a significant positive relationship between maximum temperature at seedling, vegetative and maturity stages and mustard yield. Highest relation is observed during vegetative stage ($r = 0.517$) followed by seedling stage ($r = 0.460$) and maturity stage ($r = 0.372$). However in the case of minimum temperature, no significant relationship was found at all phenological stages. Chopra (1998) reported the role of air temperature during early vegetative phase of crop is significantly important as it dominantly affects the rate of growth of biomass throughout the crop life and hence the seed yield.

Ambikapur

The relationship between maximum and minimum temperatures during different growth stages of rapeseed-mustard and yield at Ambikapur revealed that there is no significant relationship with these weather parameters (Table 3). However, it was

found that maximum temperature during seedling, reproductive and maturity phase and minimum temperature during vegetative and reproductive phase had negative relation with yield. Experiment result of Pandey *et al.* (2007) revealed that the flowering and pod development phases of the mustard were found to be most sensitive to weather parameters. Higher sunshine hours, maximum temperature ($> 30^{\circ}\text{C}$) and lower temperature ($< 14^{\circ}\text{C}$) during flowering and pod development stage of the crop were favorable for mustard crop. Temperature range was found to explain highest variation (92%) in the seed yield of mustard.

CONCLUSION

The present study aimed to find out relationship between maximum and minimum temperature during different stages of mustard crop and yield at three locations of Chhattisgarh state indicated that temperature did not influence the mustard yield uniformly in three locations. At Raipur, maximum temperature during vegetative stage showed significant negative relation whereas at Jagdalpur significant positive relation was found. Maximum and minimum temperature at any crop growth stage did not have relation with yield at Ambikapur. At the same time, minimum temperature during reproductive stage of crop showed negative relation with mustard yield in all three locations though it was not significant one. This may be attributed to higher night time temperature which might have increased the respiration rate in turn leading to over utilization of photosynthates stored in the pods.

REFERENCES

1. Singh R, Rao V U M and Singh D. Agrometeorology of Indian Brassica. *Mausam*, (5): 57-62 (2002).
2. Chopra, Usha Kiran, Effect of temperature on growth rate of three Brassica varieties. in Ahlawat IPS and Singh, Surender Extended summaries of first International Agronomy congress. *Indian Society of Agronomy, IARI*, New Delhi, p.89-90 (1998).
3. Pandey V, Vadodaria R P, Bhatt B K, Patel V J, Talati J, Shekh A M, Influence of environmental parameters on mustard yield and its quality. *Journal of Agrometeorology*, 9(1): 49-55 (2007).
4. NMCE 2009 Report on Rapeseed –Mustard. *National Multi-Commodity Exchange of India Ltd.* Ahmadabad, Gujarat. p.10.