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Frost management in mustard under climate change scenario in semi arid ecosystem of Rajasthan

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Abstract

Among various factors, in recent years climate change becomes a major challenge for the food security of the country. Extreme events such as frost, heat stress, moisture stress, new diseases, pests & weeds become a major hindrance in successful crop production. Frost (Pala, Tusar or daha in Hindi) is a localized phenomenon, which is fairly common in northern India. Due to Climate change frost becomes a regular phenomenon in recent years in semi arid regions of Rajasthan. The predominantly grown mustard (*Brassica juncea* L.) is highly susceptible to frost injury. Mustard crop suffers badly due to the attack of frost in 2006, 2008, 2010, 2011, 2012, 2013 & 2014 in Rajasthan. An experiment was conducted during Rabi seasons (2011-12 to 2013-14) at Research farm RARI Durgapura on sandy loam soil. Application of thiourea @ 500 ppm, wettable sulphur @ 0.2%, thiosalicylic acid @ 100 ppm, salicylic acid @ 100 ppm and H₂SO₄@0.1% being at par significantly increased seed and stover yield of mustard and recorded the lowest yield losses. The maximum net returns (Rs 38019/ha) along with the highest B:C ratio (2.61) was accrued due to application of thiourea followed by thiosalicylic acid and wettable sulphur. The Spray of thiourea (500 ppm), wettable sulphur (0.2%) or thio-salicylic acid (100 ppm) or salicylic acid (100 ppm) at pre flowering and seed formation stage was found to be effective in mitigating the adverse impact of frost in mustard. This study may help to understand and select suitable treatments to reduce frost impact on growing mustard in environmental conditions under semi-arid zone of India.

Keywords: Frost Management, Sulphur use, Mustard crop

Introduction

India is the fourth largest oilseed economy in the world after USA, China & Brazil. The diverse agro-ecological conditions in the country are favorable for growing 9 annual oilseed crops, among the seven edible and two non-edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% in the total oilseeds production and ranks second after groundnut sharing 27.8% in the India's oilseed economy (Shekhawat *et al.*, 2012) [4]. Mustard is cultivated in mostly under semi arid climates. It is also grown in certain semi and semi-arid regions as a cold weather crop. Indian mustard is reported to tolerate annual precipitation of 500 to 4200 mm, annual temperature of 15 to 45 °C, and pH of 6.3 to 8.5. Rapeseed-mustard follows C3 pathway for carbon assimilation. Therefore, it has efficient photosynthetic response at 15–20 °C temperature. At this temperature the plant achieve maximum CO₂ exchange range which declines thereafter. A review is prepared on advances on agronomic practices for enhancing the rapeseed-mustard production in India.

Climate change becomes a major bottlenecks for sustainable agriculture in recent years. Extreme climatic events such as frost, heat stress, moisture stress, new diseases and pests becomes a major drivers in successful crop production. Frosts or Tusar or Pala is a localized phenomenon which is fairly common in northern India. Due to Climate change frost becomes a regular phenomenon in recent years in semi arid regions of Rajasthan. The predominantly grown mustard (*Brassica juncea* L.) is highly susceptible to frost injury (Dhawan, 1985) [1]. Frost damage occurs when ice forms inside the plant tissue and injures plant cell. The extent of injury caused by frost mainly depends upon the temperature below freezing point. The period of temperature and the crop stage at which frost occurs. The freezing can be either extracellular or intracellular. The ice formation disrupts the protoplasts (Levitt, 1980) [2].

Materials & Methods

The experiment was conducted during the Rabi seasons of 2011-12, 2012-13 and 2013-14 at the Rajasthan Agricultural Research Institute (Sri Karan Narendra Agriculture University,

Jobner), Durgapura, Jaipur.

Geographically this place is situated at 75° 47' East longitude, at 26°51' North latitude and at altitude of 390 m above mean sea level in Jaipur district of Rajasthan. This region falls under Agro-climatic zone IIIa (Semi-arid eastern plain zone) of Rajasthan. The soil was sandy loam, low in organic carbon (0.27%), low in available nitrogen (139.2 kg N/ha), medium in available phosphorus (18.5 kg P/ha) and potassium contents (184.7 kg K/ha) and slightly alkaline in soil reaction (pH 7.8). The experiment was laid out in Randomized Block Design (RBD) with 3 replications. The ten treatments were randomly allotted to different plots. The ten treatment consists of T₀: Control; T₁: Water spray; T₂: H₂SO₄ @ 0.1%; T₃: Thiourea @ 500 ppm; T₄: Wettable Sulphur @ 0.2%; T₅: DMSO @ 78 gm/ha; T₆: Thiosalicylic acid @ 100 ppm; T₇: Salicylic acid @ 100 ppm; T₈: Brassionolide @ 5 ppm and T₉: Glyciobatil @ 100 ppm. Treatment application was done at pre flowering & grain filling stage. Different observations related to yield; yield loss and its economics were recorded following the standard procedures. The seed and stover yields of each net plot were recorded in kg plot⁻¹ after cleaning the threshed produce and were converted as q ha⁻¹. Cost of cultivation was calculated on the basis of prevailing market price of different inputs like labour, implements, seeds, fertilizers and chemicals, used in cultivation of mustard under different treatments. The seed and stover yields of mustard were computed into gross return on the basis of prevailing local market prices of the produce. The net return of each treatment was the gross return of individual treatment. Benefit: cost (B:C) ratio was obtained by dividing the net return by cost of cultivation. The analysis of variance of data was carried out using OPSTAT and significance was tested by 'F-test'.

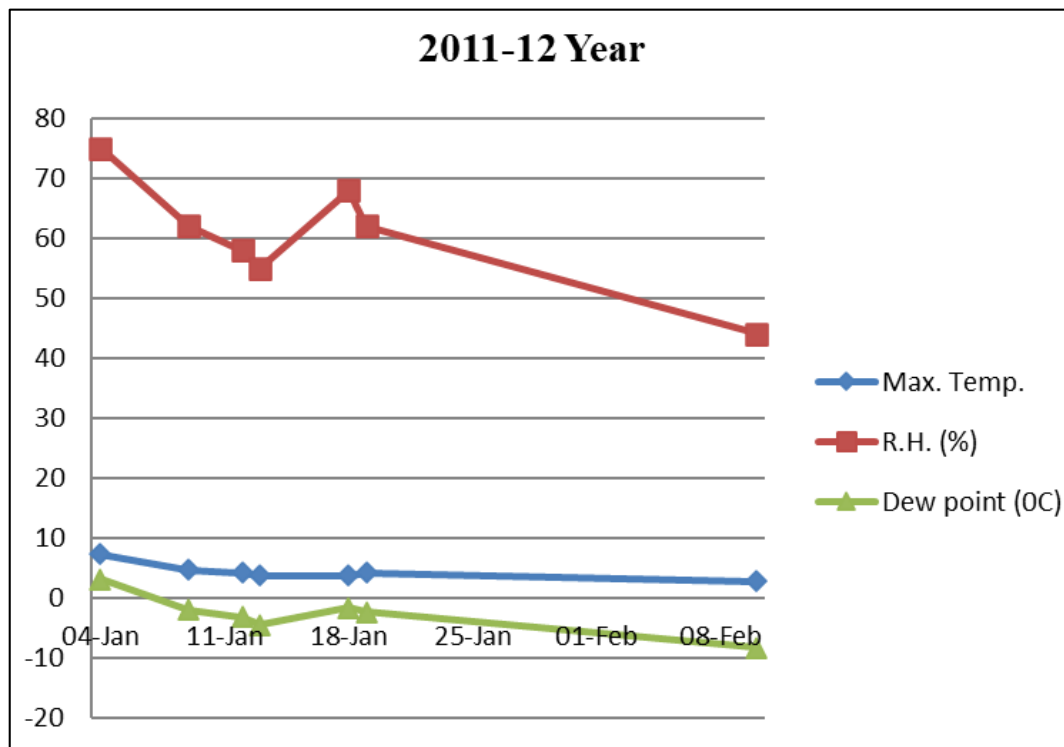
Results and Discussion

Data (Table 1.0) shows that the minimum temperature,

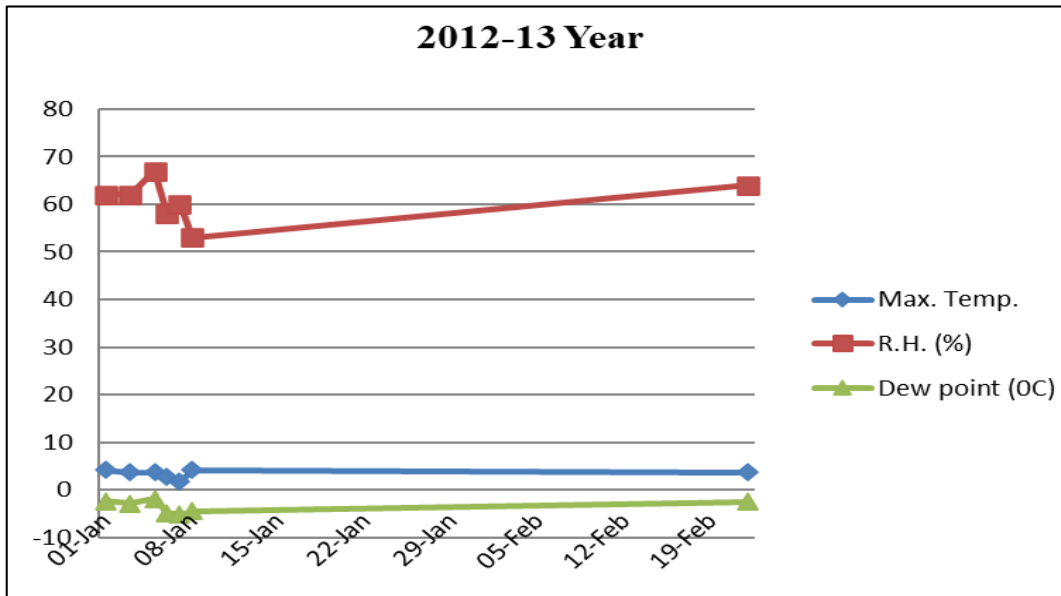
relative humidity and dew point during the experimentation period. Dew point below zero in all the years of study shows that the frost occurred in the crop. Dew point in all the years of study (2011-12 to 2013-14) ranges from -0.11 to -8.4. The lower the dew point higher will be freezing injury and vice versa.

Data (Table 2.0) depicts that on pooled basis application of thiourea @ 500 ppm, wettable sulphur @ 0.2%), thiosalicylic acid @ 100 ppm, salicylic acid @ 100 ppm and H₂SO₄ @ 0.1% being at par significantly increased seed and stover yield of mustard. Application of thiourea @ 500 ppm recorded the highest seed yield (16.03 q/ha) and stover yield (39.02 q/ha) closely followed by thiosalicylic acid and wettable sulphur. The same results were observed for 1000 grain weight. Availability of more moisture might have helped in better absorption and translocation of sulphur by mustard. Similar results have been reported by Raut *et al.* (2000) [6] and Piri *et al.*, (2012) [5].

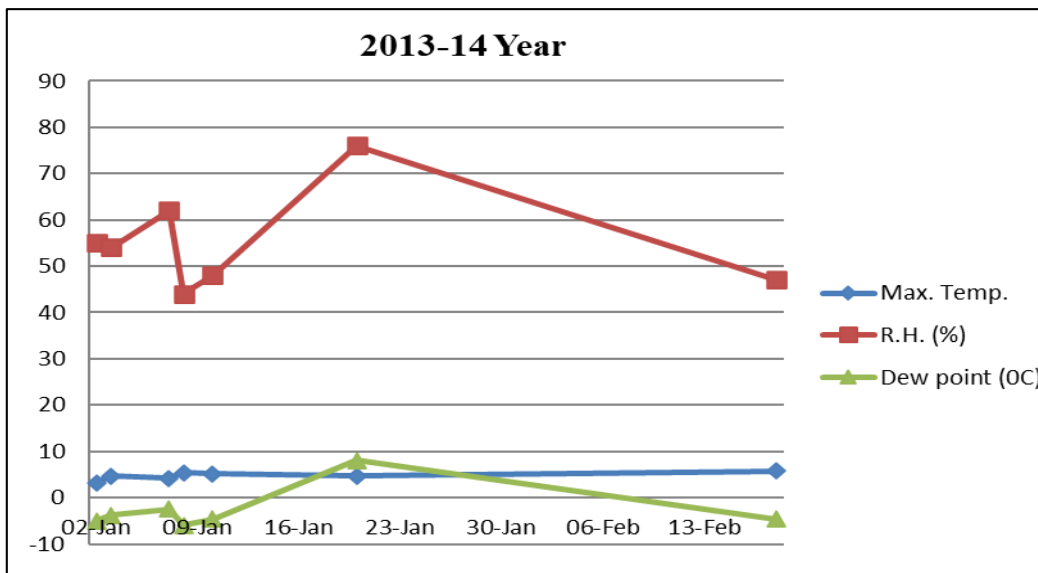
Further the mean minimum yield loss (%) i.e 10.5% was observed by the application of thiourea, followed by salicylic acid (11.8%), wettable sulphur (12.0%) and thiosalicylic acid (12.5%). The maximum net returns (Rs 38019/ha) along with the highest B:C ratio (2.61) was accrued due to application of thiourea followed by thiosalicylic acid and wettable sulphur. The sulphur content in thiourea, thiosalicylic acid and wettable sulphur might have enhanced -SH bond in plant cells that resists breakage of cell membrane & hence results in minimum loss due to frost injury. Application of wettable sulphur in mustard to provided higher economic yield, net income and benefit-cost ratio which might be associated with higher chlorophyll content and photosynthetic area to improve photosynthetic activity, plant metabolism and dry matter production. Sulphur induced high yield and benefit: cost ratio has been reported by Mitra (2006) [7] in summer green gram and by Nepalia (2005) [8] in mustard.



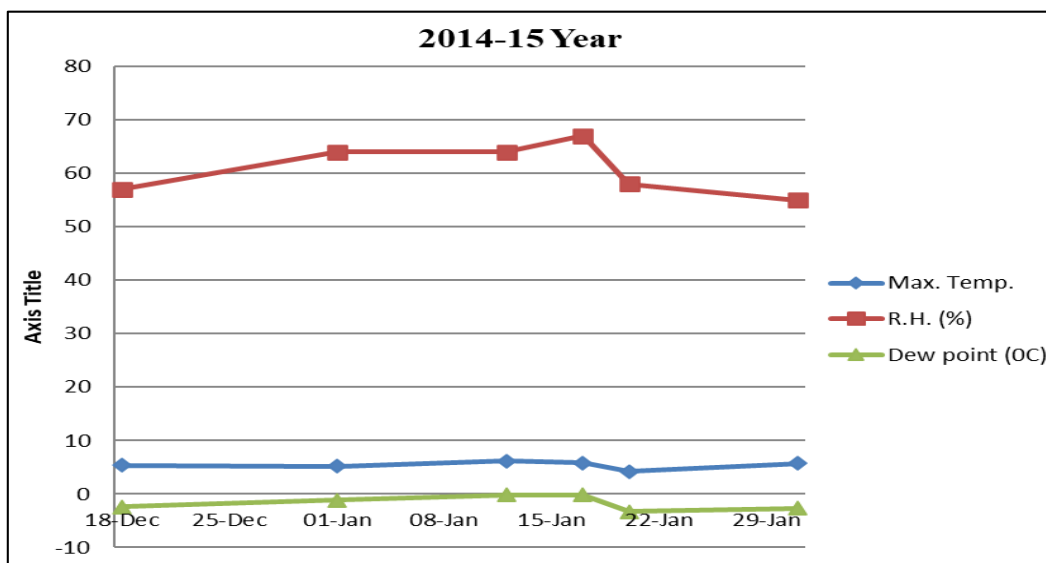
A.



B.



C.



D

Fig 1 A, B, C, and D: Year wise Minimum temperature, relative humidity and dew point during experimentation period (2011-12 to 2014-15)

Table 1: Effect of frost management practices on grain and stover yield of mustard

Treatments	Grain yield (q/ha)					Stover yield (q/ha)				
	2011-12	2012-13	2013-14	2014-15	Pooled	2011-12	2012-13	2013-14	2014-15	Pooled
T ₀ - Control	11.90	10.77	8.07	10.66	10.35	28.85	26.11	19.59	22.57	24.28
T ₁ - Water Spray	12.01	11.68	8.98	11.01	10.92	29.48	28.67	22.06	24.71	26.23
T ₂ - H ₂ SO ₄ (0.1%)	16.56	15.92	12.85	13.27	14.65	39.75	38.20	30.84	32.29	35.27
T ₃ - Thiourea (500 ppm)	20.24	18.50	15.50	9.88	16.03	47.76	43.99	36.80	29.45	39.50
T ₄ - Wettable Sulphur (0.2%)	14.13	16.99	12.82	19.46	15.85	33.90	40.77	30.76	42.65	37.02
T ₅ - DMSO (78 gm/ha)	13.45	13.30	10.36	13.69	12.70	32.27	31.91	24.87	28.79	29.46
T ₆ - Thio-Salicylic acid (100 ppm)	18.00	17.90	14.92	12.90	15.93	43.19	42.95	35.80	33.62	38.89
T ₇ - Salicylic acid (100 ppm)	16.68	16.49	13.53	11.90	14.65	40.04	39.58	32.48	38.66	36.69
T ₈ - Brassionolide (5 ppm)	13.32	15.98	11.65	9.89	12.71	31.96	38.36	27.96	37.56	33.96
T ₉ - Glyciobatil (100 ppm)	12.56	14.23	11.52	12.45	12.69	30.14	34.14	27.64	36.80	32.18
SEM±	0.65	0.84	0.62	0.77	0.62	1.51	2.03	1.44	2.19	1.34
CD (P=0.05)	1.93	2.50	1.84	2.32	1.79	4.52	5.50	4.27	6.57	3.89

Table 2: Effect of different frost management practices on test weight, yield loss and economics of mustard (on mean basis) 2011-12 to 2014-15

Treatments	1000 grain weight (gm)	Yield loss (%)	Net returns (Rs/ha)	B:C
T ₀ - Control	2.7	58.7	17147	1.76
T ₁ - Water Spray	2.8	56.8	19122	1.84
T ₂ - H ₂ SO ₄ (0.1%)	3.8	14.9	33130	2.43
T ₃ - Thiourea (500 ppm)	4.4	10.5	38019	2.61
T ₄ - Wettable Sulphur (0.2%)	4.1	12.0	36861	2.55
T ₅ - DMSO (78 gm/ha)	3.6	25.6	24912	2.05
T ₆ - Thio-Salicylic acid (100 ppm)	4.2	12.5	37327	2.56
T ₇ - Salicylic acid (100 ppm)	3.8	11.8	33390	2.45
T ₈ - Brassionolide (5 ppm)	3.2	36.4	26360	2.15
T ₉ - Glyciobatil (100 ppm)	3.1	43.8	25961	2.13

Conclusion

On the basis of aforesaid findings, it could be concluded that the successive additions of wettable sulphur salicylic acid significantly increased the availability of all forms of sulphur in the mustard. Hence, the Spray of thiourea (500 ppm), wettable sulphur (0.2%) or thio-salicylic acid (100 ppm) or salicylic acid (100 ppm) at pre flowering and seed formation stage was found to be effective in mitigating the adverse impact of frost in mustard.

References

- Dhawan A. Freezing in oil-seed Brassica spp. Some factors affecting injury. The Journal of Agricultural Science 1985;104(3):513-518. Doi:10.1017/S0021859600044270
- Levitt J. Response of plants to environmental stresses. Chilling, freezing and high temperature stresses. Academic press. New York. 1990, I.
- Oksanen E, Freiwald V, Prozherina. Photosynthesis of Birch (*Betula pendula*) sensitive to spring time frost & Ozone. Canadian Journal of Forest Research 2005;35(3):703-712.
- Shekhawat K, Rathore SS, Premi OP, Kandpal BK, Chauhan JS. Advances in Agronomic Management of Indian Mustard (*Brassica juncea* (L.) Czernj. Cosson): An Overview. International Journal of Agronomy, 2012. 408284, 14.
- Piri I, Rahimi A, Tavassoli A, Rastegaripour F, Babaeian M. Effect of sulphur fertilizer on sulphur uptake and forage yield of *Brassica juncea* condition of different regimes of irrigation. African journal of agricultural research 2012;7:958-63.
- Raut R, Abdul HF, Hadole SS, Jeughale GS. Effect of irrigation and sulphur on concentration, uptake and availability of sulphur, nitrogen and phosphorus in mustard (*B. juncea*). Journal of Soils and Crops

2000;10(1):145-148.

- Mitra AK, Banerjee K, Pal AK. Effect of different levels of phosphorus and sulphur on yield attributes, seed yield, protein content of seed and economics of summer greengram. Research Crop 2006;7(2):404-405.
- Nepalia V. Influence of weed control and sulphur on growth, yield and economics of mustard production. Research on Crops 2005;6:35-38.