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IMPACT OF FOLIAR SPRAY OF BIOREGULATORS IN TERMINAL HEAT STRESS CONDITION ON TEST WEIGHT, OIL CONTENT AND SEED VIABILITY OF MUSTARD (*BRASSICA JUNCEA* L.)

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Abstract–The experiment was conducted during the years 2019-20 & 2020-21 at Oil Seed Farm of C. S. Azad University of Agriculture & Technology Kanpur. Two varieties namely Kanti (V1) and Maya (V2) seeds were sown in *Rabi* 2019 and 2020 and seven chemicals concentrations of bioregulators were applied as foliar spray treatments at vegetative stage, at anthesis stage and at both stage *viz*., Salicylic acid (SA) 800 ppm (T_1, T_8 and T_{15}), Salicylic acid spray at vegetative stage @ 400 ppm (T_2, T_9 and T_{16}), Ascorbic acid (AA) 10 ppm (T_3, T_{10} and T_{17}), Potassium chloride (KCl) 1% (T_4, T_{11} and T_{18}), thiourea (TU) 400 ppm (T_5, T_{12} and T_{19}), Cycocel (CCC) 800 ppm (T_6, T_{13} and T_{20}), Cycocel 400 ppm (T_7, T_{14} and T_{21}) and T_0-Control (without spray). Freshly harvested seeds were investigated for test weight (1000 seed weight), oil content % and seed viability % and significantly maximum test weight (4.57g) and seed viability (98.46%) recorded from the treatment T_{19} followed by treatment T_{16} as compared to control, while on oil content % no significant effect of treatment was recorded. Variety Maya showed significantly superior performance on test weight and oil content over variety Kanti but seed viability did not differ signicantly.

INTRODUCTION

Indian mustard *(Brassica juncea)* belongs to the Brassicaceae family. In India, *Brassica* oilseeds are collectively referred to as rapeseed mustard, which is the most important *Rabi* oilseed crop. India is one of the largest rapeseed mustard growing countries in the world, ranking first in area and second in production after China. The oil content in rapeseed and mustard varies from 30-49% depending on the species and the growing atmosphere. Mustard growing areas in India experience tremendous diversity in agro-climatic conditions and different varieties are grown in different parts of the country. Area, production and productivity of mustard canola is 6856.27 k ha, 9123.64 MT, 13.31 q/ha in 2019-20 (Anonymous, 2020). Mustard oil has the lowest amount of harmful saturated fatty acids. It also contains a sufficient amount of essential fatty acids, i.e. linoleic and linolenic acids. Mustard is also used as a green vegetable, it is rich in sulfur and minerals.

Indian mustard is sown late due to delayed harvest of rainy season crops (Kumar *et al*., 2013) Late sown Indian mustard is exposed to high temperature coupled with high atmospheric evaporative demands during the reproductive phase leading to forced maturity, increased aging and low productivity (Porter, 2005). High temperature stress negatively affects plant growth and crop yield (Boyer, 1982). Camejo *et al*., (2005) reported that tolerance to environmental stress is interconnected and involves several changes at the whole-plant, cellular, and molecular levels. These stresses have a negative impact on the photosynthetic system of higher plants Hall (1992) reported that flowering is the most sensitive stage to damage by heat stress, probably due to vulnerability during pollen development, anthesis and fertilization, leading to reduced crop yield, this reduced crop yield is also associated with reduced seed quality. Seed quality is primarily determined by its purity, viability, germination and vigour, the test weight is also a measure of vigour. After germination, larger seeds retain a larger portion of their food reserves that can be mobilized for seedling growth (Green and Junpper, 2004).

Only a good crop can produce quality seeds.

High quality seeds play an important role in successful crop production and ensure seed quality, i.e. test weight, oil content, viability etc. of production. Only a stress-tolerant variety can establish a good crop under adverse conditions and produce good quality seed (Akjun and Al-Tindal, 2010). The use of various bioregulators plays a very important role in the production of quality seed. bioregulators develop plant resilience to withstand in stress conditions by modifying plant growth behavior. Poor seed quality results in low test weight, slower germination, low vigor and viability. Considering all these facts, this experiment was planned to determine the effect of foliar spray of bioregulators under terminal heat stress conditions on test weight, oil content and seed viability of mustard (*Brassica juncea* L.)

MATERIALS AND METHODS

The field experiment was conducted at Oil Seed Farm, CSAUA &T, Kanpur, during *Rabi*, 2019-20 and 2020-21. Geographically, Kanpur is situated in sub tropical zone at 25°26' and 26°58' N latitude and 79°32' and 80°34' E longitude with an altitude of 125.90 m above mean sea level.

The experimental materials were consisted of two mustard varieties namely Kanti (V_1) and Maya (V_2). To mitigate terminal heat stress the following bio regulators (chemicals), their concentrations and stage of spray were applied T_0-Control, T_1-SA spray at vegetative stage @ 800 ppm, T_2-SA spray at vegetative stage @ 400 ppm, T_3-AA spray at vegetative stage @ 10 ppm, T_4-KCl spray at vegetative stage @ 1%, T_5-TU spray at vegetative stage @ 400 ppm, T_6-CCC spray at vegetative stage @ 800 ppm, T_7-CCC spray at vegetative stage @ 400 ppm, T_8-SA spray at anthesis stage @ 800 ppm, T_9-SA spray at anthesis stage @ 400 ppm, T_{10}-AA spray at anthesis stage @ 10 ppm, T_{11}-KCl spray at anthesis stage @ 1%, T_{12}- TU spray at anthesis stage @ 400 ppm, T_{13}-CCC spray at anthesis stage @ 800 ppm, T_{14}-CCC spray at anthesis stage @ 400 ppm, T_{15}-SA spray at vegetative + anthesis stage @ 800 ppm, T_{16}-SA spray at vegetative + anthesis stage @ 400 ppm, T_{17}-AA spray at vegetative + anthesis stage @ 10 ppm, T_{18}-KCl spray at vegetative + anthesis stage @ 1%, T_{19}-TU spray at vegetative + anthesis stage @ 400 ppm, T_{20}- CCC spray at vegetative + anthesis stage @ 800 ppm and T_{21}-CCC spray at vegetative + anthesis stage @ 400 ppm. The harvested seed were subjected for investigation as

Test Weight (g)

One thousand well air dried seeds from produce of each plot were counted and weighed in g with the help of electronic balance and the mean value was taken to represent 1000 seed weight.

Oil Content %

Oil content was tested with the help of NIRS digital analyzer. 100g sample of each plot was tested and results showed by NIRS digital analyzer was recorded.

Seed Viability %

Seed viability was tested through tetrazolium test (%). The tetrazolium viability test (Moore, 1973) based on three replication of 100-seeds each was followed. The seed were moistened for 16 h at room temperature. After peeled off the seed coat, the seeds were stained in 0.5 per cent tetrazolium chloride solution, pH 7.0 for 4-5 at 38 °C. The number of seeds stained entirely red were considered as viable seeds and expressed in percentage.

The recorded data of individual years was analyzed statistically and error variance was tested for homogeneity by F-test. Further, if the years were found homogeneous, the data were subjected for pooled analysis. However, interpretation of the results have been made on the pooled data basis only.

RESULTS AND DISCUSSION

Between the two varieties variety Maya (V_2) was found to be significantly superior in test weight and oil content except seed viability % this may be because of the freshly harvested seed lot have highest seed quality which may not show significant difference however, maximum test weight (3.91g), oil content (38.38%), seed viability (93.79%) was recorded in V_2 over V_1. There findings were in accordance with the findings of (Rai *et al.* 2017) who found that performance of mustard varieties in differ each other for seed viability, similar findings were reported by (Das *et al.*, 2020).

Among foliar spray of bioregularors significantly maximum test weight (4.57g), seed viability (98.46%) was recorded from treatment T_{19} followed by treatment T_{16} and lowest value was recorded from control, while oil content % did not show any significant effect due to the treatments. This may be due to higher accumulation of photo assimilates at

Table 1. Impact of foliar spray of bioregulators on test weight, oil content and seed viability of mustard varieties

Treatments	Test weight (g)			Oil content %			Seed viability %		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_0	3.01	3.38	3.20	37.93	38.99	38.46	86.53	86.76	86.65
T_1	3.53	3.80	3.66	37.98	38.48	38.23	93.17	93.41	93.29
T_2	3.58	3.83	3.71	37.95	38.65	38.30	93.71	93.94	93.83
T_3	3.23	3.40	3.31	38.15	38.53	38.34	89.68	89.91	89.80
T_4	3.30	3.42	3.36	38.19	38.31	38.25	90.50	90.73	90.61
T_5	3.87	4.10	3.99	38.03	37.67	37.85	94.28	94.51	94.40
T_6	3.47	3.70	3.59	37.89	38.44	38.17	92.46	92.69	92.58
T_7	3.49	3.73	3.61	38.08	37.69	37.88	92.60	92.84	92.72
T_8	3.50	3.83	3.66	38.34	38.24	38.29	93.67	93.91	93.79
T_9	3.55	3.87	3.71	38.30	38.70	38.50	94.58	94.82	94.70
T_{10}	3.26	3.36	3.31	38.13	38.34	38.23	92.18	92.41	92.29
T_{11}	3.33	3.39	3.36	38.29	38.48	38.38	92.60	92.84	92.72
T_{12}	3.93	4.30	4.11	37.89	37.81	37.85	95.37	95.60	95.48
T_{13}	3.48	3.72	3.60	37.90	38.97	38.43	92.60	92.84	92.72
T_{14}	3.50	3.73	3.62	38.49	38.52	38.50	93.57	93.80	93.68
T_{15}	4.06	4.43	4.25	38.82	38.57	38.70	96.35	96.58	96.47
T_{16}	4.13	4.50	4.31	38.45	38.68	38.56	96.46	96.69	96.57
T_{17}	3.96	4.05	4.01	38.44	38.05	38.24	93.67	93.91	93.79
T_{18}	4.03	4.16	4.09	36.88	37.67	37.28	93.96	94.19	94.08
T_{19}	4.34	4.81	4.57	37.52	39.19	38.36	98.35	98.58	98.46
T_{20}	4.04	4.24	4.14	38.24	38.29	38.26	95.74	95.98	95.86
T_{21}	4.06	4.40	4.23	38.14	38.19	38.16	96.17	96.40	96.29
Mean	3.67	3.91		38.09	38.38		93.55	93.79	
	V	T	VxT	V	T	VxT	V	T	VxT
S.E.(d)	0.02	0.06	0.09	0.14	0.48	0.67	0.14	0.46	0.66
C.D. at5 %	0.04	0.13	N.S.	0.29	N.S.	N.S.	N.S.	0.92	N.S.

sink. The application of thiourea Enhanced source strength, sucrose translocation to the developing seed, increased pod photosynthesis and oil biosynthesis (Pandey *et al.*, 2013). This findings corroborates the findings of Sharma and Jain, (2003) in mustard, and (Shanu, 2013) in coriander.

The interaction of mustard varieties with chemicals spray treatments were not found to be significant for improving the quality of seed produced under terminal heat stress on pooled data basis of both the years.

CONCLUSION

Foliar spray of thiourea at vegetative + anthesis stage @ 400 ppm is effective for the enhancement of test weight and seed viability of mustard in terminal heat stress condition, within variety. Variety Maya is better than variety Kanti and can be recommended to the farmers.

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