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Effect of seed priming treatments along with micropot techniques for quality seed production in sunflower (*Helianthus annuus* L.)

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ABSTRACT

To determine the effect of different seed priming treatments and micropot techniques in sunflower, field experiments were conducted at C-Block Farm (Incheck Farm), Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal during the rabi seasons of 2019-2020 and 2020-2021 in sunflower variety (WBSH-2021). The experiment used a split plot design with the micropot technique as the first component, seven priming treatments (Hydro priming, Solid matrix priming, Osmotic priming, Halo priming, Hormonal priming, Vermi priming, Bio priming) along with control as the second factor, and three replications. Seed priming was employed as a subplot treatment, while the micropot method was used as the main plot treatment. Days to 50% flowering, basal girth (cm), number of leaves plant^{-1}, plant height (cm), days to maturity, head diameter (cm), number of seeds head^{-1}, seed setting percent, seed length (mm), seed breadth (mm), 100 seed weight (g), hulling percent, seed yield plant^{-1} (g) were all measured according to standard procedure. Some seed quality parameters like germination percentage (%), seedling length (cm), seedling dry weight (mg seedling^{-1}) and vigour index were studied to judge the seed quality parameters of harvested seeds. Considering various morphological characters, T_4 (Halo priming) followed by T_7 (Bio priming) was earliest to 50% flowering (63.8 and 64.0 days respectively). T_4 (Halo priming) recorded earliest days to maturity (119.2 days) and it was followed by T_8 (control) with 121.1 days. Maximum seed yield plant^{-1} (75.6 g) was noted in T_6 treatment followed by T_7 treatment (73.6 g) due to larger head, more number of seeds head^{-1}, maximum seed setting percentage, seed length, seed breadth and maximum 100 seed weight. Germination percentage was highest (88.79 %) in T_3 (Osmotic priming) due to better filling of seeds. Maximum seedling length (17.57 cm) and vigour index-I (1522.54) was recorded in T_6 (Vermi priming) treatment. The performance of crop for different morphological and yield contributing characters was better in micropot techniques than without micropot techniques. Therefore, vermi priming and bio priming along with micropot techniques are potentially able to promote rapid and uniform plant growth, thereby improving the yield and seed quality of sunflower.

***Keywords*:** Micropot, seed priming, seed production, seed quality, sunflower

INTRODUCTION

In India, sunflower (*Helianthus annuus* L.2n=34) plays an important role to the total oilseed production after soybean and rapeseed-mustard. Sunflower was first grown in the country's south to increase oilseed production. Thereafter it was spread to other states of India like Orissa, Bihar and West Bengal. Due to late harvest of *kharif* rice or due to water scarcity, the majority of the area in Eastern India remains fallow in the subsequent rabi season, so there is a scope for horizontal expansion of oilseed crops such as sunflower. There is an estimate of rice fallow in Bihar (3 lakh hectare), Chhattisgarh (28.5 lakh hectare), Jharkhand (4.75 lakh hectare), West Bengal (12 lakh hectare) and 12.2 lakh hectare in Orissa (Jagadev *et. al*., 2016). In the rice fallow areas or in the monoplot rice fallow areas, scunflower is emerging as an important oilseed crop in different states. Besides this, environment friendly techniques like seed priming will help in development of high vigour seedling to mitigate the adverse abiotic condition.

Seed priming is a useful technique for enhancing emergence speed and uniformity as well as achieving a high degree of vigour, resulting in improved crop establishment and production even in harsh weather circumstances (Finch-Savage and Bassel, 2016).

Recent techniques like development of seedling through micropot along with seed priming is another scope for improvement of seedling vigour before transplanting. Sometimes it becomes impossible to operate land in optimum moisture condition due to water logging in low lying areas. Under this condition seedlings can be raised under micropot and transplanted in the main field under zero tillage condition without disturbing the soil-physical properties. There is no work on sunflower in micropot seedling development but it is in practice in West Bengal for raising seedlings of mustard crop followed by transplanting. The present research work has been attempted to study the growth and development of hybrid sunflower varieties under Gangetic West Bengal condition through micropot techniques.

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MATERIALS AND METHODS

The present investigation was conducted during rabi season of 2019-2020 and 2020-2021 at C-Block Farm (Incheck Farm), Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia,West Bengal. The research station is located in West Bengal's Gangetic alluvial zone (latitude: 22.57°N, longitude: 88.20°E, elevation: 9.75 MSL). The experiment was laid out in split plot design with micropot techniques as first factor and seven seed priming treatments (T_1- Hydro priming, T_2- Solid matrix priming, T_3- Osmotic priming, T_4- Halo priming, T_5- Hormonal priming, T_6- Vermi priming, T_7- Bio Priming) along with control (T_8- Dry Seed) as second factor. Seeds of variety WBSH-2021, collected from Pulses and Oilseed Research station, Berhampore, West Bengal was treated by maintaining standard protocol of seed priming which are as follows:

T_1 (Hydropriming): The seeds (10g) were steeped in 100 ml distilled water for 24 hours. After that seeds were forced air dried to their original weight after soaking. (Bennett and Waters, 1987)

T_2 (Solid matrix priming): Gunny bags were used for solid matrix priming. Ten gram seeds were placed in two wet gunny bags for 24 hours under shade (Bennett and Waters, 1987). After matri priming, seeds were washed three times with distilled water and dried to their original weight with forced air in the shade (Khan *et al*., 1992).

T_3 (Osmotic priming): Seeds (10g) were immersed in an aerated PEG-6000 solution with a pressure of -0.2 MPa for 12 hours (Bennet and Waters, 1987). After osmo priming, seeds were washed three times with distilled water and dried to their original weight with forced air in the shade.

T_4 (Halo priming): Ten gram seeds were steeped in an aerated solution of KNO_3 (@0.05mol) for 12 hours. Seeds were rinsed three times in distilled water after halopriming and forced air dried in the shade to their original weight (Khan *et al.,* 1992).

T_5 (Hormonal priming): Seeds (10g) were immersed in an aerated GA_3 solution (0.04%) for 12 hours. After hormonal priming, the seeds were rinsed three times with distilled water and forced air dried to their original weight in the shade (Sundstrom *et al.,* 1987).

T_6 (Vermi priming): Seeds (10g) were soaked in diluted solutions of vermin wash (100 ml) for 12 hours followed by washing and drying the seeds up to its original weight under shade.

T_7 (Bio Priming): Seeds (10g) were soaked in distilled water (100ml) for 12 hours. Soaked seeds were inoculated with 50g *Azatobactor* culture, dried in shade and were sown in micropot as well as in field.

T_8 [Control (Dry Seed)]: All the treated seeds were sealed in airtight container and placed in refrigerator at 8±2ºC till further use. Micropots (M) were filled up with 50 per cent soil and 50 percent organic manure. Two seeds were planted in each pot, treatment-wise in eight trays, and watered on a regular basis. The surplus seedlings were removed after seven days, leaving one seedling per micropot. In three replicated plots, ten-day-old seedlings were transplanted in a well-prepared field according to treatment. Simultaneously, rest-treated seeds were sown directly in the field (2 seeds per hill) with the same treatment and replication as without the micropot (WM) treatment. The excess seedlings in the directly sown plots were removed keeping one seedling per hill at 7-10 days after sowing.

The size of plots in both micropot and as well as without micropot was 3m x 1.8m with spacing of row to row- 30 cm and plant to plant- 20cm. Date of sowing was 23.11.2019 and 15.11.2020. Recommended doses of fertiliser N: P_2O_5:K_2O @ 80: 100: 100 $kgha^{-1}$ was applied. 50% Nitrogen, 100% P_2O_5, 100% K_2O was applied as basal and remaining 50% N was applied in two splits at 30 days and 50 days after sowing after thinning and weeding. Earthing up was done at 40 days after sowing. Plant protection measure was followed as per necessity. Five (5) randomly selected plants from each treatment as well as replication were tagged for taking observation of different morphological and yield attributing parameters like days to 50% flowering, basal girth (cm), number of leaves $plant^{-1}$, plant height (cm), days to maturity, head diameter (cm), number of seeds $head^{-1}$, seed setting %, seed length (mm), seed breadth (mm), 100 seed weight (g), hulling %, seed yield $plant^{-1}$ (g). The seed quality parameters like seedling length (cm), seedling dry weight (mg $seedling^{-1}$) and vigour index were investigated at laboratory of department of Seed Science and Technology, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia. Pooled data over two years comprising field and laboratory parameters was analysed statistically as per split plot design (Two factor analysis) by using OP STAT Computer programme developed by CCS, HAU, HISAR. Laboratory data were analysed following FCRD design (Two factor analysis).

RESULTS AND DISCUSSION

A. Growth parameters

At the maturity stage, substantial differences in plant height were detected after application of several seed priming treatments (Table 1). Hormonal priming (T_5) preceeded by vermi priming (T_6), had the minimum plant height (115.2 and 116.9 cm respectively). Bio priming (T_7), followed by osmotic priming ($T_{3)}$, had maximum

Fig. 1: Growth of plants in Micropot

Fig. 2: Transplanting of seedlings

Table 1: Response of seed priming and micropot techniques on growth parameters

Treatments	Plant height (cm)	Days to 50 % flowering	Days to maturity	Basal girth (cm)	Number of leaves plant^{-1}
T_1	126.5	69.3	129.2	3.9	22.4
T_2	123.3	68.4	123.2	3.8	21.9
T_3	130.2	64.8	121.3	4.2	25.0
T_4	118.5	63.8	119.2	4.2	20.7
T_5	115.2	65.0	121.4	4.3	20.2
T_6	116.9	65.8	128.1	4.8	23.0
T_7	141.4	64.0	123.1	5.9	28.6
T_8	121.4	68.8	121.1	3.9	20.1
SEm (±)	**0.793**	**0.362**	**0.735**	**0.168**	**0.483**
LSD (0.05)	**2.428**	**1.109**	**2.251**	**0.363**	**1.481**
Micropot	**127.8**	**63.0**	**121.3**	**4.4**	**23.8**
Without micropot	**120.6**	**69.4**	**125.4**	**4.3**	**21.7**
SEm (±)	**0.480**	**0.216**	**0.347**	**0.053**	**0.214**
LSD (0.05)	**1.450**	**0.653**	**1.050**	**NS**	**0.649**
Interaction (T×M)					
SEm (±)	**1.244**	**0.564**	**1.011**	**0.159**	**0.646**
LSD (0.05)	**3.782**	**1.173**	**3.079**	**0.485**	**1.968**

Legend: T_1: Hydro priming, T_2: Solid matrix priming, T_3: Osmotic priming, T_4: Halo priming, T_5: Hormonal priming, T_6: Vermi priming, T_7: Bio priming, T_8: Dry seed (Control), NS: Non Significant

plant height (141.4 and 130.2 cm respectively). With a substantial statistical difference, the micropot plants had a larger plant height (127.8 cm) than the non-micropot plants (120.6 cm). Significant differences were noticed after the application of several seed priming treatments for the character days to 50% flowering and maturity. Hydro priming had the longest duration to 50% flowering (69.3 days), followed by control plot (68.8 days). Halo priming (T_4) had the shortest duration (63.8 days), preceeded by bio priming (64.0 days). The application of halo priming and bio priming took shorter time for maturity, however the difference was not significant. With a substantial statistical difference, plants under micropots had earlier days to 50% flowering and maturity than plants under without micropots. There was significant differences in basal girth and number of leaves plant^{-1} also. The bio priming treatment had the maximum basal girth (5.9 cm) and leaves plant^{-1} (28.6) while, it was minimum for Solid matrix priming (3.8 cm) preceeded by hydro priming and control (Table 1). The micropot had non significant effect on basal girth but had significant effect on the number of leaves plant^{-1}. Numerically, the micropot plants had higher basal girth than without micropot plants. The interaction effects between seed priming treatments and micropot plants had significant effect for all the growth parameters.

B. Seed yield and it's attributing characters

Significant difference was observed in seed yield plant^{-1} and its attributing characters like head diameter (cm), number of seeds head^{-1}, seed setting %, seed length (mm), seed breadth (mm), 100 seed weight (g) after application of different seed priming treatments as well as in micropot treatments. Maximum head diameter (16.3 cm) was observed in T_7 (Bio priming) followed by T_6 (Vermi priming) with 15.9 cm. Minimum head diameter was noted for T_2 (Solid matrix priming) with 12.8 cm. Maximum number of seeds head^{-1} (1009.7) was recorded

Table 2: Response of seed priming and micropot techniques on seed yield and it's attributing characters

Treatments	Head diameter (cm)	No. of seeds head^{-1}	Seed setting percentage (%)	Seed length (mm)	Seed breadth (mm)	100 seeds weight (g)	Hulling percentage (%)	Seed yield plant^{-1} (g)
T_1	15.1	890.9	76.5	10.9	7.2	7.4	29.4	68.2
T_2	12.8	904.3	75.6	9.7	6.4	7.0	29.4	65.4
T_3	13.5	952.8	80.7	10.7	7.4	6.9	29.4	69.1
T_4	14.3	965.3	78.8	10.6	7.5	7.8	29.2	69.0
T_5	14.6	938.8	80.0	11.3	7.5	7.9	29.4	68.8
T_6	15.9	1000.7	86.5	12.0	8.4	8.8	28.5	75.6
T_7	16.3	1009.7	85.7	11.7	8.2	8.0	29.7	73.6
T_8	13.8	894.1	80.9	10.4	7.2	6.9	30.0	65.3
SEm (±)	**0.177**	**13.106**	**0.796**	**0.138**	**0.116**	**0.088**	**0.379**	**0.529**
LSD (P=0.05)	**0.541**	**40.138**	**2.438**	**0.423**	**0.356**	**0.270**	**NS**	**1.620**
Micropot	**15.0**	**989.9**	**83.9**	**11.5**	**8.1**	**8.0**	**28.6**	**72.7**
Without micropot	**14.0**	**899.2**	**77.3**	**10.4**	**6.8**	**7.2**	**30.2**	**66.1**
SEm (±)	**0.142**	**9.157**	**0.242**	**0.045**	**0.090**	**0.042**	**0.195**	**0.289**
LSD (P=0.05)	**0.428**	**27.689**	**0.731**	**0.135**	**0.271**	**0.127**	**0.589**	**0.874**
Interaction (T×M)								
SEm (±)	**0.334**	**22.521**	**0.931**	**0.165**	**0.213**	**0.122**	**0.544**	**0.783**
LSD (0.05)	**1.013**	**NS**	**2.842**	**0.502**	**0.648**	**0.371**	**NS**	**2.382**

Legend: T_1: Hydro priming, T_2: Solid matrix priming, T_3: Osmotic priming, T_4: Halo priming, T_5: Hormonal priming, T_6: Vermi priming, T_7: Bio priming, T_8: Dry seed (Control), NS: Non Significant

Table 3: Response of seed priming and micropot techniques on seedling quality parameters

Treatments	Germination percentage (Tr value)	Seedling length (cm)	Seedling dry weight (mg seedling^{-1})	Vigour index-I	Vigour index-II
T_1	87.84 (70.03)	15.86	90.08	1394.49	7916.24
T_2	87.96 (70.14)	14.67	87.33	1291.32	7684.88
T_3	88.79 (70.89)	15.77	91.08	1402.95	8091.01
T_4	85.69 (68.18)	15.93	89.92	1365.75	7705.87
T_5	85.05 (67.66)	16.65	90.58	1416.84	7705.95
T_6	86.81 (69.13)	17.57	96.08	1522.54	8340.60
T_7	85.52 (68.04)	17.29	95.08	1481.02	8137.67
T_8	84.31 (67.06)	15.06	84.33	1271.21	7112.06
SEm (±)	**1.971**	**0.287**	**0.899**	**36.454**	**207.712**
LSD (0.05)	**NS**	**0.829**	**2.603**	**105.490**	**601.072**
Micropot	**87.90 (70.08)**	**17.51**	**92.54**	**1537.88**	**8135.13**
Without micropot	**85.09 (67.69)**	**14.69**	**88.58**	**1248.65**	**7538.44**
SEm (±)	**0.985**	**0.143**	**0.450**	**18.227**	**103.856**
LSD (0.05)	**NS**	**0.415**	**1.301**	**52.745**	**300.536**
Interaction (T×M)					
SEm (±)	**2.787**	**0.405**	**1.272**	**51.554**	**293.750**
LSD (0.05)	**NS**	**1.173**	**3.681**	**149.185**	**NS**

Legend: T_1: Hydro priming, T_2: Solid matrix priming, T_3: Osmotic priming, T_4: Halo priming, T_5: Hormonal priming, T_6: Vermi priming, T_7: Bio priming, T_8: Dry seed (Control), NS: Non Significant

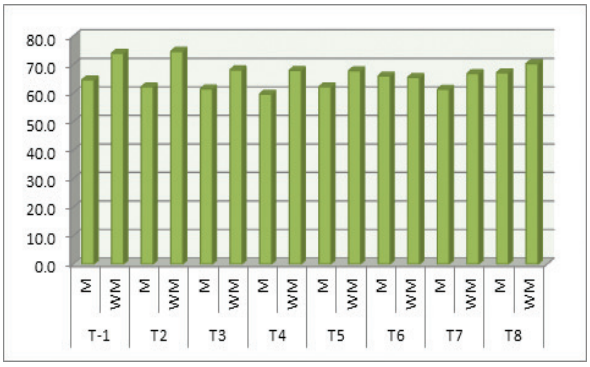

Fig. 3: Relationship between days to 50% flowering and seed treatments

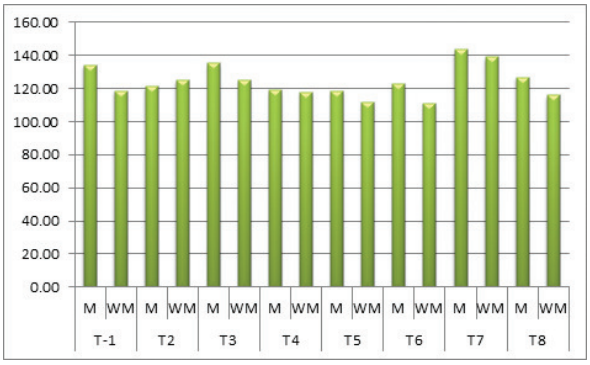

Fig. 4: Relationship between plant height and seed treatments

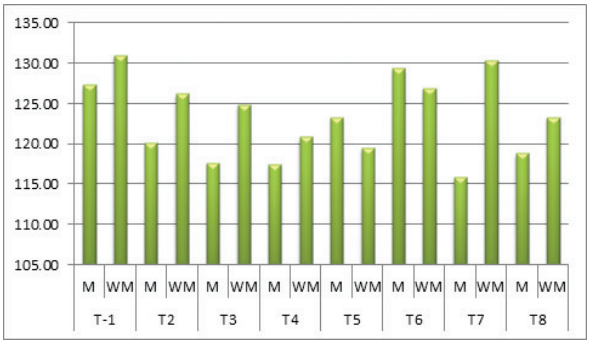

Fig. 5: Relationship between days to maturity and seed treatments

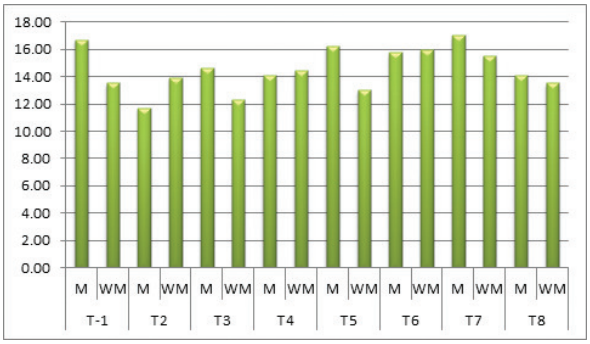

Fig. 6: Relationship between head diameter and seed treatments

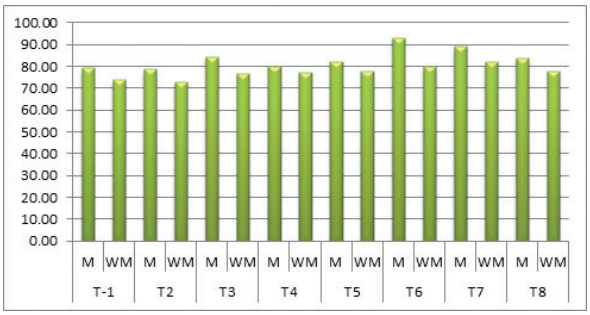

Fig.7: Relationship between seed setting percentage and seed treatments

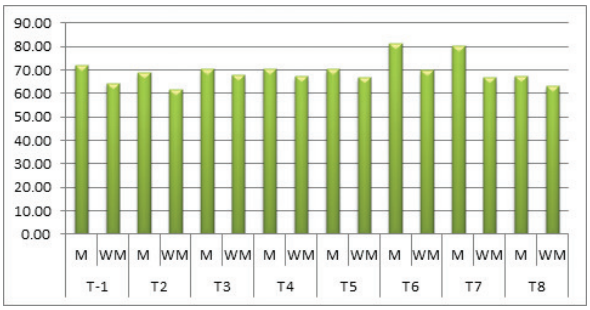

Fig. 8: Relationship between seed yield plant^{-1} and seed treatments

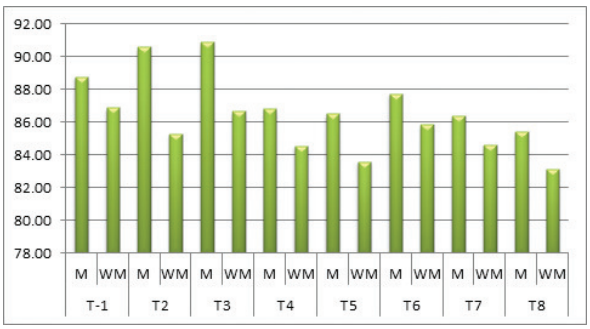

Fig. 9: Relationship between germination percentage and seed treatments

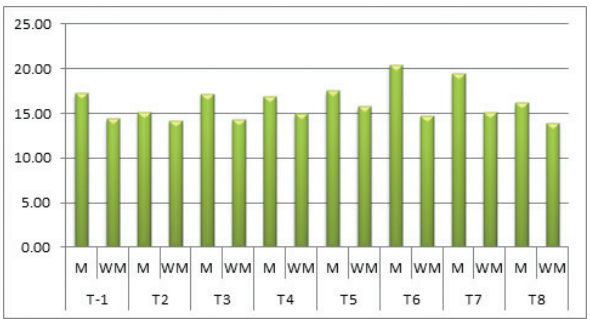

Fig. 10: Relationship between seedling length and seed treatments

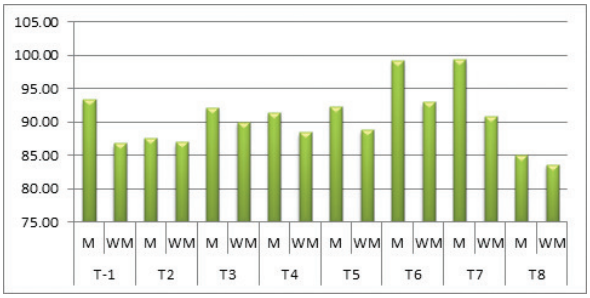

Fig. 11: Relationship between dry weight seedling^{-1} and seed treatments

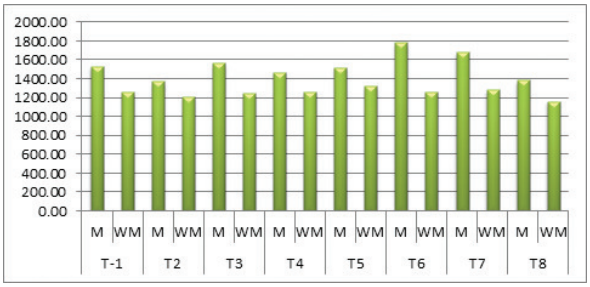

Fig. 12: Relationship between vigour index-I and seed treatments

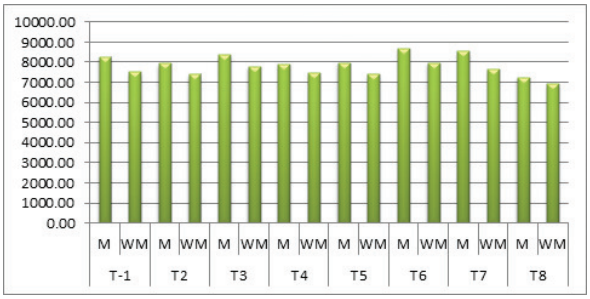

Fig.13: Relationship between vigour index-II and seed treatments

in T_7 (Bio priming) followed by T_6 (Vermi priming) with 1000.7 seeds. Minimum number of seeds head^{-1} (890.9) was observed in T_1 (Hydro priming) treatment preceded by control (T_8) and solid matrix priming (T_2) with 894.1 and 904.3 seeds. Maximum seed setting percentage was noted in T_6 (Vermi priming) followed by bio priming with non significant difference (86.5 & 85.7 per cent respectively). Minimum seed setting percentage (75.6%) was observed in T_2 (Solid matrix priming). In case of seed length maximum value (12.0 mm) was noted in T_6 (Vermi priming) followed by T_7 (Bio priming) with 11.7 mm. Minimum seed length (9.7 mm) was observed in T_2 (Solid matrix priming). Maximum seed breadth (8.4 mm) was recorded in T_6 (Vermi priming) followed by T_7 (Bio priming) whereas minimum seed breadth (6.4 mm) was observed in T_2 (Solid matrix priming). In case of 100 seed weight maximum value (8.8 g) was recorded in T_6 (Vermi priming) followed by T_7 (Bio priming) with 8.0 g. Minimum 100 seed weight (6.9 g) was noted both in T_3 (Osmotic priming) and T_8 (Control). Similar type of observations was noted by Sarkar *et al.* (2021) during study of seed bio priming with microbial bioinoculants . Sunflower hulls are a by-product of sunflower seed dehulling, which is done before the seeds are used for oil extraction or bread components. Minimum hulling percentage (28.5) was observed in T_6 (Vermi priming) whereas maximum hulling percentage (30.0) was noted in T_8 (Dry seed as control) treatment.

Micropot developed plant when transplanted in the field, recorded greater head diameter (15.0 cm), number of seeds head^{-1} (989.9), seed setting percentage (83.9), seed length (11.5 mm), seed breadth (8.1 mm) and 100 seed weight (8.0 g) than the without micropot plants. There was significant variation due to interaction between seed priming treatments and micropots for all yield attributing charactets except number of seeds head^{-1} and hulling percentage.

The influence of yield contributing characters resulted in higher seed yield plant^{-1} (75.6 g) under T_6 (Vermi priming) treatment because seed yield is a complex and quantitative variable that is affected by genetic and environmental factors. It is also noted that micropot derived plants had higher seed yield plant^{-1} than without micropot plants (72.7 and 66.1g respectively) may be due to higher vigour of micropot plants. Same type of results was observed in tomato by Brar *et al.* (2015). Same trend was noted in sunflower by Bera *et al.* (2018).

C. Seedling quality parameters

The most critical criterion for seed quality is germination. The minimum germination percentage in sunflower should be 70%, according to Indian minimum seed certification standards. Under storage conditions, sunflowers lose germination and vitality quickly, hence the initial germination percentage is very much important. Seed priming treatment had no significant effect in germination percentage, however micropot methods caused significant variation. It was revealed from Table 3 that, maximum germination percentage (88.79) was noted for T_3 (Osmotic priming) treatment and minimum germination percentage (84.31) was noted for T_8 (Dry seed as control) treatment. Similar observation was found by EL-Barghathi and El-Bakkosh (2005) in *Quercus coccifera*. Maximum seedling length

(17.57 cm) was noted for T_6 (Vermi priming) treatment followed by T_7 (Bio priming) with 17.29 cm and minimum seedling length (14.67 cm) was noted for T_2 (Solid matrix priming) treatment. In case of seedling dry weight, maximum value (96.08 mg seedling^{-1}) was recorded in T_6 (Vermi priming) treatment and minimum value (84.33 mg seedling^{-1}) was observed in T_8 (Dry seed as control) treatment. Maximum vigour index (1522.54) was recorded in T_6 (Vermi priming) treatment followed by T_7 (Bio priming) treatment (1481.02). Minimum value (1271.21) of vigour index was observed in T_8 (Control). Similar ttrend was also noted for vigour index –II, where maximum value (8340.60) was recorded in T_6 (Vermi priming) t followed by T_7 (bio priming).

CONCLUSION

T_4 (Halo priming) was the earliest to 50% flowering, followed by T_7 (Bio priming), with no statistically significant difference between the treatments. Among growth parameters, seed yield plant^{-1} was maximum in case of T_6 (Vermi priming) treatment followed by T_7 (Bio priming) which was due to better performance of the crop for most of the yield attributing characters. Seedlings grown in micropots followed by transplanting into the main field performed better than directly sown seed. As a result, this low-cost micropot technique, along with seed priming, will have advantages in adverse soil moisture and will eliminate the problems associated with late rapeseed-mustard sowing in fallow areas to bring more areas under sunflower cultivation.

Furthermore, the approach is easy, inexpensive, and does not necessitate a great deal of experience or specialised equipment. Farmers may be advised to achieve higher germination and uniform emergence under adverse field condition in order to maximise oilseed production.

REFERENCES

Bennett, M.A. and Waters, L. Jr.1987. Seed hydration treatments for improved sweet maize germination and stand establishment. *J. American Soc. Hortic. Sci*., **112**: 45-49.

Bera, S., Banerjee, S. and Soren, C.2018. Performance of sunflower as influenced by establishment technique and weed management. *Int. J. Curr. Microbiol. Appl. Sci.,***7**(5): 3193-3198.

Brar, N. S., Thakur, K. S., Kumar, R. and Mehta, D. K. 2015. Yield and quality of tomato seed and soil fertility as affected by organic manures and biofertilizers. *Green Farming* , **6**: 1068-1070.

EL-Barghathi, M.F. and El-Bakkosh, A. 2005. Effect of some mechanical and chemical pretreatments on seed germination and seedling growth of *Quercus coccifera* (Kemes oaks). J. Jerash Private University.

Finch-Savage, W.E. and Bassel, G.W. 2016. Seed vigour and crop establishment:extending performance beyond adaptation. *Journal of Experimental Botany.* 67:567– 591.

Jagadev, P. N., Garnayak, L. M., Paikaray, R. K., Sahu, Rath B. S. and Sahoo, S. C. 2016. OUAT strategies for pulse production in rice fallows of Odisha.

Khan, A.A., J.D. Maguire.,Abawi, G.S. and Illas, S. 1992. Matriconditioning of vegetable seed to improve stand establishment in early field planting. *J. American Soc. Hortic. Sci.,***117**: 41-47.

Sarkar, D., Singh, S., Parihar, M. and Rakshit, A. 2021. Seed bio-priming with microbial inoculants: A tailored approach towards improved crop performance, nutritional security, and agricultural sustainability for smallholder farmers. *Curr. Res. Environ. Sust.,* **3** :100093.

Sundstrom, F.J., Reader, R.B. and Edwards, R.L. 1987. Effect of seed treatment and planting method on Tabasco pepper. *J. American Soc. Hortic. Sci.,***112**: 641-644.