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OFF SEASON BOTTLE GOURD CULTIVATION USING PLASTIC MULCH AND LOW TUNNEL

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ABSTRACT : The bottle gourd belongs to family of Cucurbitaceae and important environmental factors affecting its germination are air & soil temperature during growing season, hence it very difficult to cultivate during winter season. The seed of two varieties of bottle gourd (Tulsi and Warad) were sown under various treatment conditions i.e. open field, open field with black plastic mulch, plastic low tunnel, black plastic mulch with plastic low tunnel and transparent plastic mulch. The germination of bottle gourd varied under various treatment conditions and also affected by varieties of bottle gourd (Tulsi and Warad). The highest yield for Tulsi was found to be 49.2 t/ha under black plastic mulch with plastic low tunnel but for Warad it was found to be 64.4 t/ha under transparent plastic mulch.

Keywords : *Bottle gourd, air temperature, plastic mulch, plastic low tunnel and yield*

Bottle gourd (*Lagenaria siceraria* (Mol.) Standley) is an important vegetable plant belongs to family Cucurbitaceae and largely cultivated in the tropics and subtropics areas. It is having a wide range of uses, such as its edible fruits, which are good source of carbohydrates and calcium, the pulp and leaves have medicinal properties (Decker-Walter, 2).

Bottle gourd gives optimum yield at sunny days and warm climate. It grows well in sandy loam soils rich in organic matter. Sandy soil and a constant temperature of 30°C is ideal for optimum seed germination (Singh *et al.,* 7) and germination is nil at 350C (Solanki and Seth, 8). The broad temperature range required for its proper growth and high fruit set are night and day temperature of 18-22°C and 30-35°C respectively. The seed is normally sown during summer and rainy season.

Plasticulture is the art of using plastic materials to modify the production environment in crop production. It has developed into management systems that allow growers to achieve higher quality produce, superior yields and extended production cycles. Production of vegetables under protected structures such as low tunnel provides the best way to increase the productivity and quality of vegetables, especially cucurbits. The low tunnels represent the standard method for using plastics to enhance the growth of most vegetable crops (Wells and Loy, 10). A low arch (typically less than 0.75 m centre height) of perforated clear polyethylene or non-woven fibre is supported above the crop using wire hoops. Typically, a single row of the crop is protected by each cover. By increasing air and soil temperatures, reducing wind damage and by providing a degree of frost protection, the low tunnels accelerate crop development and extend the growing season (Waterer, 9).

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The low tunnel can be used round the year for cultivation and vegetable nursery growing by providing suitable environments using different cladding materials. The cladding material which can be used to cover the wire hoops are UV stabilized plastic film (50 micron), insect net proof material (40 mesh) and shade net material (Green & 50%). The most important parameters which affect the crop yield & its quality are soil temperature, air temperature & light intensity and it does vary round the year. During winter season the soil and air temperature is low, so the UV stabilized plastic film (up to 50 micron) alone or both plastic film & insect net proof material (40 mesh) can be used to increase the soil temperature and air temperature.

The low tunnels technology is mainly suitable for off season cultivation of cucurbits like muskmelon, round melon, long melon, bitter grand, bottle gourd and summer squash etc. Apart from off season cultivation of cucurbits it can be also be used for cultivation of cabbage/cauliflower during summer, leafy vegetables such as coriander/ spinach etc. during rainy season.

Mulch is a protective cover placed over the soil, primarily to modify the effects of local climate. It is well established technology in vegetables cultivation but the success of mulching depends on the selection of right mulching material. The various factors affect the mulch selection but most important is season of cultivation. Depending upon the season of cultivation, the purpose

of mulching will change, in winter there is need to increase the soil temperature but in summer reduction in the soil temperature, apart from other benefit of mulching. There are numerous other advantages to plastic mulches such as improved fruit quality, reduced weed problems, reduced water evaporation, increased yield, reduced fertilizer leaching, reduced soil compaction, improved phytochrome response, and other benefits.

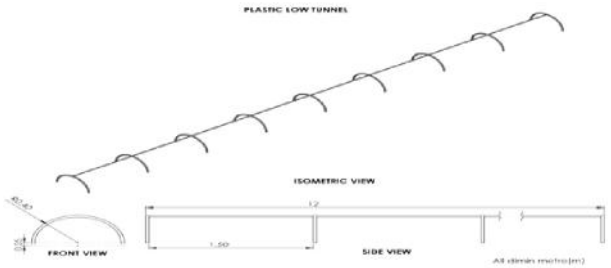
Plastic mulches can reflect, absorb and transmit incoming sunlight, the extent of which depends on the type of mulch. The soil temperature under plastic mulch depends on the thermal properties (reflectivity, absorbitivity, or transmittancy) of particular mulch in relation to incoming solar radiation. The beneficial effect of most plastic mulches is an increase in temperature which has shown to be beneficial to most plants. The soil temperature has direct dramatic effects on microbial growth and development, organic matter decay, seed germination, root development, and water & nutrient absorption by roots (Decoteau, 3). The black plastic mulch (25 micron) found to be effective during winter because it increases the soil temperature by 1-30C in comparison to open field condition. This plastic mulch is usually used in combination with plastic low tunnel (Ibarra et. al., 6). The plastic mulch and low tunnel with cladding of transparent plastic film can be used to make the environmental condition (soil & air temperature) conducive for seed sowing of bottle gourd during fag end of winter season to cultivate off season bottle gourd. The study was conducted to study the effect of plastic mulch and low tunnel on off season cultivation of bottle gourd.

MATERIALS AND METHODS

The research was conducted at PFDC farm, Birsa Agricultural University, Ranchi, Jharkhand. The soil type is sandy loam and bottle gourd was irrigated using drip irrigation system. The bottle gourd seeds used for cultivation were Tulsi (Euro Seed International Pvt. Ltd, Jaipur) and Warad (MAHYCO, Mumbai). The study was conducted during December 2015 to May 2016 and area used was 200 m2. The wire hoop of iron rode (8.02 mm) was used construct low tunnel with radius of 40 cm and both end of wire hoop was put into soil for 5 cm. The plastic mulches used were of black (25 micron) & transparent (50 micron) and the clear plastic film (transparent) of 50 micron were used for cladding the low tunnel. The geometry of plastic low tunnel in 3D is designed using Solidworks 2016. The raised bed of 80 cm width were used for crop growing with spacing of 2 m × 1.5 m and fertilizer dose of 87:52:139 kg/ha. The irrigation was given through drip irrigation system. The black plastic mulch and transparent mulch were fixed on raised bed. The seeds of bottle gourd were sown under black plastic after making circular holes in mulch film but in transparent mulch first seeds were sown and circular holes were cut after germination of seed. The transparent cladding material used over low tunnel was removed by the end of February 2016 due to rise of air temperature. The data recorded were germination, number of fruits and yield of bottle gourd. The seeds were sown on 29 December 2015 and treatment taken for this study were T_1- open field, T_2- open field with black plastic mulch, T_3- plastic low tunnel, T_4- black plastic mulch with plastic low tunnel and T_5- transparent plastic mulch.

RESULTS AND DISCUSSION

The isometric view of plastic low tunnel with details specification is shown in Fig. 1 which was used over raised bed to cover the seed bed.



The germination of bottle gourd seed after 58 days of sowing on 25.02.16 is given in Table 1. It is clear from table that for various treatments there is wide variation in germination of seed and it also varies with seed varieties. The germination of Warad is substantial better than Tulsi under various growing condition. The number of germinated plants varied between 5 to 8 and 7 to 12 for Tulsi and Warad respectively. The monthly average mean air temperature recorded at PFDC farm by Department of Agro meteorology & Environmental Science, BAU, Ranchi that during December 2015 and January 2016, February 2016 varied between 6.6 to 27.60C. The minimum and maximum temperature measured during above months varied between 10C to 33.30C. It is clear that under open field condition both soil and air temperatures were below the required temperature need for successful cultivation of bottle gourd (Singh *et. al.,* 7).

It is clear from Table 1 that the germination under black plastic mulch is better than open field condition for Warad because black plastic mulch is effective during winter because it increases the soil temperature by 1-3°C in comparison to open field condition (Ham *et. al.,* 4).

Table 1 : Germination of bottle gourd on 25.02.2016.

Treatments	Variety (Tulsi)	Variety (Warad)
T_1-open field	0	7
T_2-open field with black plastic mulch	0	9
T_3-plastic low tunnel	6	9
T_4-black plastic mulch with plastic low tunnel	5	12
T_5-transparent plastic mulch	8	10

The plant growth of bottle gourd (Warad) under open field & open field with black plastic mulch are given in Fig. 1 and Fig. 2, respectively.

The germination of bottle gourd under plastic low tunnel is better than open field due to high air temperature which enhances soil temperature under low tunnel. The high air temperature under low tunnel is due to green house effect because of two different effects i.e. (i) a confinement effect, resulting from the decrease in the air exchanges with the outside environment; and (ii) an effect caused by the existence of a cover characterized by its low transparency to far infrared radiation (emitted by the crop, the soil), but its high transparency to sunlight (Baudoin *et al.,* 1).

Fig. 1 : Bottle Gourd (Warad) under open field.

Fig. 2 : Bottle gourd (Warad) under open field with black plastic mulch.

Fig. 3 : Bottle gourd (Warad) under plastic low tunnel.

Fig. 4 : Bottle gourd (Warad) under black plastic mulch with plastic low tunnel.

The germination under black plastic mulch with plastic low tunnel was found to better than open field, open field with black plastic mulch & plastic low tunnel is evident from Table 1 (specially for Warad). Due to synergistic effect of black plastic mulch and plastic low tunnel, soil temperature under this case is expected to more favorable for germination of bottle gourd.

The plant growth of bottle gourd (Warad) under plastic low tunnel & black plastic mulch with plastic low tunnel are given in Fig. 3 and Fig. 4, respectively.

The germination of bottle gourd (Tulsi) under transparent plastic mulch is found to be better than other four treatments (T1 to T4) because it is expected that rise in soil temperature is more favorable than other treatments. Mulch's color affects the temperature below & above the mulch though the absorption, transmission & reflection of solar energy and soil temperature under plastic mulch follows the order transparent mulch > black mulch > white mulch (Haynes, 5). The transparent plastic mulch absorbs little solar radiation but transmits 85% to 95%, with relative transmission depending on the thickness and degree of opacity of the polyethylene. It is generally are

used in the cooler regions because it provides an even warmer soil environment (mini-greenhouse effect) than black plastic mulch.

The plant growth of bottle gourd (Warad) under transparent plastic mulch is shown in Fig. 5.

Fig. 5 : Bottle gourd (Warad) under transparent plastic mulch.

The number of fruits for bottle gourd (Tulsi and Warad) under various treatments (T_1 to T_5) on 04.04.16 is given in Table 2. The number of fruits varied between 23 to 30 & 14 to 25 respectively for Tulsi and Warad under various treatments. The variation in number of fruits of bottle gourd followed the same trend as explained above for germination of bottle gourd under various treatments.

Table 2 : Number of fruits of bottle gourd on 04.04.16.

Treatments	Variety (Tulsi)	Variety (Warad)
T_1- open field	0	14
T_2- open field with black plastic mulch	0	25
T_3- plastic low tunnel	23	25
T_4- black plastic mulch with plastic low tunnel	26	22
T_5- transparent plastic mulch	30	16

The yield of bottle gourd (Tulsi and Warad) under various treatments (T_1 to T_5) on 04.04.16 is given in Table 3. The yield of bottle gourd varied between 27.6 t/ha to 49.2 t/ha & 20.1 t/ha to 64.4 t/ha respectively for Tulsi and Warad under various treatments. The highest yield for Tulsi was found to be 49.2 t/ha under black plastic mulch with plastic low tunnel (T_4) but for Warad it was found to be 64.4 t/ha under transparent plastic mulch (T_5) which is not significant higher than 63.3 t/ha found under black plastic mulch with plastic low tunnel (T_4).

Table 3 : Yield of bottle gourd (t/ha).

Treatments	Variety (Tulsi)	Variety (Warad)
T_1- open field	0	20.1
T_2- open field with black plastic mulch	0	33.5
T_3- plastic low tunnel	27.6	38.6
T_4- black plastic mulch with plastic low tunnel	49.2	63.3
T_5- transparent plastic mulch	31.3	64.4

CONCLUSION

The cultivation of bottle gourd is difficult during winter season due to low air & soil temperature. The plasticulture technology i.e. plastic mulching & low tunnel was used for off season cultivation of two seed varieties of bottle gourd (Tulsi and Warad). The germination and number of fruits are found to be highest under transparent plastic mulch (50 micron) for Tulsi while for Warad it found to be under black plastic mulch (25 micron) with plastic low tunnel (cladding with transparent plastic film of 50 micron). The highest yield for Tulsi is found to be 49.2 t/ha under black plastic mulch with plastic low tunnel but for Warad it found to be 64.4 t/ha under transparent plastic mulch. The result shows that apart from soil & air temperature during cultivation season the selection of seed also affects the performance of bottle gourd cultivation.

REFERENCES

1. Baudoin W., Nono-Womdim R., Lutaladio N., Hodder A., Castilla N., Leonardi C., Pascale S. D., Qaryouti M. (2013). Good Agricultural Practices for greenhouse vegetable crops: *Principles for Mediterranean Climate Areas.* FAO, Rome.
2. Decker-Walter D.S., Wilkins-Ellert M., Chung S. M. and Staub J. E. (2004). Discovery and genetic assessment of wild bottle gourd (Lagenaria siceraria (Mol.) standley, Cucurbitacae) from Zimbabwe. Eco. Bot., **58** : 501-508.
3. Decoteau D. (1998). *Plant physiology*: Environmental factors and photosynthesis. Greenhouse Glazing & Solar Radiation Transmission Workshop, October 1998 CCEA, Center for Controlled Environment Agriculture, Rutgers University Cook College.
4. Ham J. M., Kluitenberg G. J.and Lamont W. J. (1993). Optical Properties of Plastic mulches affect the field temperature regime. *J. Amer. Soc. Hortic. Sci.,* **118** (2) : 188-193.
5. Haynes R.J. (1987). The use of polyethylene mulches to change soil microclimate as revealed

by enzyme activity and biomass nitrogen, sulphur and phosphorus. Biol. Fertil. Soil, **5** (3) : 235-240.

6. Ibarra L., Flores L. and Diaz-Derez J. C. (2001). Growth & yield of muskmelon in response to plastic mulch and row covers. *Scientia Hort.,* **87** : 139-145.
7. Singh P.V., Singh M. B. and Khanna A. N. (1973). Germination studies on bottle gourd (*Lagenaria siceraria* (Mol.) Standley). *Seed Res.,* **1** : 63-66.
8. Solanki S.S. and Seth J. N. (1981). A note on the physical factors affecting coefficient velocity of germination of bottle gourd and methi seeds. *Prog. Hort.,* **13** : 57-60.
9. Waterer D. R. (1992). Influence of planting date and row covers on yields and crop values for bell peppers in Saskatchewan. *Canadian J. Plant Sci.,* **72** : 527-533.
10. Wells O. S. and Loy J. B. (1993). Row covers and high tunnels enhance crop production in the northeastern United States. *HortTech.,* **3** : 92-95.

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