

Effect of Micrometeorological Parameters on Growth and Yield of Brinjal(*solanum melongena* L.) under different Planting Windows.

ABSTRACT

An experiment “Effect of weather parameters on growth, yield and insect pest infestation on brinjal varieties under different planting windows” was carried out at Faculty of Agriculture Department of Agricultural Meteorology Farm, Centre for Advanced Agricultural Meteorology, College of Agriculture, Pune during Kharif seasons of 2014 and 2015. The experiment was laid out in split plot design with three replications. The treatment comprised of three brinjal hybrids viz., V1: Phule Arjun, V2: Krishna, V3: Panchganaga as main plot and four planting windows viz., P1: 31st MW (30 July-5 August), P2: 32nd MW (6-12 August), P3: 33rd MW (13-19 August) and P4: 34th MW (20-26 August) as sub plot treatments.

In micrometeorological studies of the higher radiation absorptions and lower reflection was absorbed under hy. Phule Arjun as compared to hy. Krishana and hy Panchganaga. The maximum Incident PAR ($1270 \text{ u mol m}^{-2}\text{s}^{-1}$) Intercepted PAR ($86.47 \text{ u mol m}^{-2}\text{s}^{-1}$), Absorbed PAR ($1094.4 \text{ u mol m}^{-2}\text{s}^{-1}$) and Radiation use efficiency (2.43 gmMJ m^{-2}) was observed in hy .Phule Arjun.

Cumulative GDD, HTU and PTU at the end of each growth stages showed that numerically higher requirement was observed in hy. Phule Arjun over hy. Krishana and hy. Panchganaga hybrids during both year 2014 and 2015 experimentation period. Whereas, the lowest canopy temperature was found in hy. Phule Arjun ($29.0 \text{ }^{\circ}\text{C}$) than rest of the brinjal hybrids. Canopy reflected PAR and transmitted PAR was higher in (191.54 and $188.62 \text{ } \mu \text{ mol}$

m⁻²s⁻¹) Panchganaga hybrids among the brinjal hybrids.

INTRODUCTION

Brinjal or egg plant (*Solanum melongena* Linnaeus) is from Solanaceae family belonging to genus *Solanum* and known as “King of vegetables”. It is a native of India. It is an important vegetable crop grown throughout the country all the year round. Brinjal crop requires a long warm climate for its growth. Temperatures ranging between 25-32⁰C are suitable for its cultivation. It does not prefer cool or frosty weather and requires silt loam to clay loam soil [1,2]. Determination of optimum planting windows is considered an important effort to have optimum yields and keep insect pest damage below economic threshold level (ETL) both quantitative and qualitative traits of crops depend on planting on the proper windows and growing season. In India higher brinjal quality Prolonged periods of low or high temperatures or sudden change in them adversely affect the insect development [3,4]. Different levels of humidity and rainfall, likewise, increase or reduce the population of certain insect pest species (Prasad & Logiswan, 1997). These factors affect the life cycle, propagation, and outbreaks of insects to such an extent that they are either compelled to adapt themselves to the changing climatic conditions and is extensively cultivated in Kharif and Rabi season. Timings of the management activities are crucial for the implementation of pest management tactics and consuming higher doses of pesticides [5-7]. High yield and quality of vegetables depends on high seed quality of improved cultivars, in addition to the optimum cultural practices. Information on crop, its stages and the week by week weather during the crop season is essential for proper management of agriculture and better crop yield.

MATERIALS AND METHODS

The field experiment was conducted at Department of Agricultural Meteorology Farm, College of Agriculture, Pune during kharif seasons of 2014 and 2015. The experiment was conducted in a split plot design with three replications. The treatments were allotted randomly to each replication by keeping the gross plot size 4.5m x 3.75 m² and net plot size 2.7 m x 2.7 m² with 90 x 75 cm spacing. There were twelve treatment combinations. The experiment was laid out in split plot design with three replications. The treatment comprised of three brinjal hybrids viz., V1: Phule Arjun V2: Krishna, V3: Panchganga as main plot and four planting windows viz., P1: 31MW (30 July- 3Aug), P2: 32nd MW (6 Aug- 12 Aug), P3: 33rd MW (13Aug- 19 Aug) P4: 34th MW (20 Aug- 26 Aug) as sub plot treatments.

RESULTS AND DISCUSSION

The micrometeorological parameters have direct influence on crop growth, development and final yield of the crops. Therefore, micrometeorological studies viz., incident, intercepted, transmitted, reflected, canopy reflected, Soil reflected, absorbed and photosynthetically active radiation, light units were undertaken.

Incident photosynthetically active radiation (*IPAR*)

Effect of hybrids

The values of *IPAR* recorded higher (1270 and 1373 $\mu\text{mol}/\text{m}^2/\text{s}$) in both the years i.e. 2014 and 2015 in hybrids Phule Arjun than other two hybrids viz. Krishna and Panchaganga. The *IPAR* increased with the age of the crop, leaf area and leaf area index increased up to 70 DAT and thereafter it declined till harvest. This was followed by hy.krishna and panchganga. The

lowest (977 and 1033 $\mu\text{mol}/\text{m}^2/\text{s}$) *IPAR* values in both the years are recorded in hybrids Panchaganga.

Effect of planting windows

The *IPAR* increased as the age of the crop advances, leaf area and leaf area index upto 70 DAT and thereafter it declined till harvest. The *IPAR* value decreased due to decrease in leaf area and leaf area index owing to senescence of leaves. The 31st MW planting windows recorded higher values of *IPAR* (1377 and 1393 $\mu\text{mol}/\text{m}^2/\text{s}$) in both the years i.e. 2014 and 2015 and gradually decreased with delayed planting. At 34th MW recorded the lowest *IPAR* values (943 and 949 $\mu\text{mol}/\text{m}^2/\text{s}$) in both the years than rest of the planting windows.

Absorbed photosynthetically active radiation (APAR)

Effect of hybrids

The values of *APAR* recorded higher (952.54 and 1029.75 $\mu\text{mol}/\text{m}^2/\text{s}$) in both the years i.e. 2014 and 2015 in hybrids Phule Arjun than other two hybrids viz., Krishna and Panchaganga. The *APAR* increased with the age of the crop, leaf area and leaf area index increased up to 70 DAT and thereafter it declined till harvest. The lowest (729.75 and 774.75 $\mu\text{mol}/\text{m}^2/\text{s}$) *APAR* was observed in both the years i.e. 2014 and 2015 were recorded in hybrids Panchaganga than rest of the hybrids

Effect of planting windows

The *APAR* increased with the age of the crop, leaf area and leaf area index increased up to 70 DAT and thereafter it declined till harvest. The *APAR* value decreased due to decrease in leaf area and leaf area index owing to senescence of leaves. The 31st MW planting windows recorded higher (919.50 and 1044.75 $\mu\text{mol}/\text{m}^2/\text{s}$) *APAR* in both the years i.e. 2014 and 2015 values of *APAR* and gradually decreased with delayed planting. At 34th MW

recorded the lowest (707.25 and 711.75 $\mu\text{mol}/\text{m}^2/\text{s}$) in both years i.e. 2014 and 2015 of *APAR* than rest of the planting windows.

Intercepted photosynthetically active radiation (*IPAR*)

Effect of hybrids

The values of *IPAR* recorded higher in *hy.Phule Arjun* (86.47 and 89.62 $\mu\text{mol}/\text{m}^2/\text{s}$) in both the years of 2014 and 2015 than other two hybrids viz., *Panchaganga* and *Krishna*. The *IPAR* increased with the age of the crop, leaf area and leaf area index up to 56 DAT and thereafter it declined till harvest. The *IPAR* value decreased due to decrease in leaf area and leaf area index owing to senescence of leaf. The lowest *IPAR* values are recorded in hybrids *Panchaganga* (83.43 and 84.44 $\mu\text{mol}/\text{m}^2/\text{s}$) in both the years i.e. 2014 and 2015 than rest of the hybrids. This might be due to inherent genetic potential of Hybrids and poor growth of crops resulted in low leaf area index. These results are in corroborative with the findings of Sandhu and Horton (1978), Idso *et al.* (1981) and Jackson (1981).

Effect of planting windows

The *IPAR* increased with the age of the crop, leaf area and leaf area index up to 56 DAT and thereafter it declined till harvest. The *IPAR* value decreased due to decrease in leaf area and leaf area index owing to senescence of leaf. The 31st MW planting windows recorded higher values (87.13 and 91.81 $\mu\text{mol}/\text{m}^2/\text{s}$) of *IPAR* in both years i.e. 2014 and 2015 and gradually decreased with delayed planting. This might be due to rapid growth of crops, proper planting window and adequate soil moisture. Planting during 34th MW recorded the lowest (80.54 and 83.38 $\mu\text{mol}/\text{m}^2/\text{s}$) *IPAR* in both years than rest of the planting windows.

This might be due to poor growth of crops resulted in low leaf area index. Crop planted on the earliest windows attained the highest leaf area

index (LAI), absorbed the largest amount of photosynthetically active radiation (PAR) and produced the highest total dry matter (DM).

Reflected photosynthetically active radiation by canopy + soil (*RPARcs*)

Effect of hybrids

The values of *RPARcs* recorded higher (27.8 and 30.1 $\mu\text{mol}/\text{m}^2/\text{s}$) in hybrids Phule Arjun than other two hybrids *viz.*, Panchganga and Krishna. The *RPARcs* decreased with the age of the crop, leaf area and leaf area index increased up to 70 DAT and thereafter it declined till harvest. The lowest *RPARcs* values (21.3 and 22.6 $\mu\text{mol}/\text{m}^2/\text{s}$) were recorded in hybrids Panchganga than rest of the hybrids.

Effect of planting windows

The *RPARcs* increased with the age of the crop, leaf area and leaf area index increased up to 70 DAT and thereafter it declined till harvest. The *RPARcs* value decreased due to decrease in leaf area and leaf area index owing to senescence of leaves. The 31st MW planting windows recorded higher values of (28.5 and 30.2 $\mu\text{mol}/\text{m}^2/\text{s}$) *RPARcs* and gradually decreased with delayed planting. At 34th MW recorded the lower values of (22.0 and 24.5 $\mu\text{mol}/\text{m}^2/\text{s}$) *RPARcs* than rest of the planting windows. The high LAI persistence and PAR interception, coinciding with the vegetative phase appeared to be mainly responsible for the increased yield in early planting. Radiation use efficiency decreased as planting was delayed, but did not have much effect on dry matter accumulation in various phases nor on final yields. These results are in conformity with the findings of Okusanya (1978), Zieslin and Tsujita (1990).

Canopy Temperature

Effect of hybrids

Among the Hybrids the canopy temperature ($^{\circ}\text{C}$) remained more or

less similar over total growing period of the crop during both the years of 2014 and 2015. The hybrids Panchganga recorded the highest canopy temperature from 28 DAT (28.4 and 29.0°C) to harvest (27.1 and 28.0 °C) as compared to hybrids Phule Arjun and Krishna. Among the hybrids, the canopy temperature (°C) remained more or less similar over total growing period of the crop during both the years of 2014 and 2015. The Phule Arjun hybrids recorded significantly lower canopy temperature among the brinjal hybrids. Whereas, higher canopy temperature found in Panchganga than the rest of the brinjal hybrids. The canopy temperature found increasing trend with Panchganga followed by Krishna and Phule Arjun, respectively in 2014 and 2015. These results are in conformity with the findings of Singh *et al.* (1983) and Kadam *et al.* (1984).

Effect of planting windows

Data presented in Table below showed that during the year 2014 and 2015, canopy temperature (°C) from 28 DAT to at harvest experienced by the crop showed increased with later planting windows (P1-31st MW to P4-34th MW) recorded the similar results that canopy temperature increased from emergence to harvesting with delay in planting windows. The lower values of canopy temperature recorded at 31st MW (P1) at 28 DAT (26.9 to 27.4) and at harvest (25.6 to 26.5). Which were gradually increased with delayed sowings in 34th MW (P4). The highest canopy temperature was recorded in 34th MW (P4) at 28 DAS (27.9 and 28.4) planting windows to till harvest (26.7 and 27.6) during both the years 2014 and 2015.

Transmitted photosynthetically active radiation (TPAR)

Effect of hybrids

The data indicated that the highest *TPAR* was observed in hybrids Panchganga (316.63 and 318.88 $\mu\text{mol}/\text{m}^2/\text{s}$) in both the years i.e. 2014 and

2015 which was gradually decreased up to 56 DAT and thereafter increased gradually up to harvest. As leaf area and leaf *area* index increases the *TPAR* decreases. The lowest *TPAR* values (312.63 and 318.88 $\mu\text{mol}/\text{m}^2/\text{s}$) observed in hy.Phule Arjun of *IPAR* in both years the i.e. 2014 and 2015.

Effect of planting windows

The *TPAR* decrease with the age of the crop, leaf area and leaf area index up to 70 DAT and thereafter it increase till harvest. The *TPAR* value increased due to decrease in leaf area and leaf area index owing to senescence of leaves. The 34th MW planting windows recorded higher values (324.26 and 33.74 $\mu\text{mol}/\text{m}^2/\text{s}$) *TPAR* in both years i.e. 2014 and 2015 of *TPAR* and gradually decreased with early planting. This might be due to rapid growth of crops, proper planting window and adequate soil moisture. At 31th MW recorded the lowest (298.90 and 304.88 $\mu\text{mol}/\text{m}^2/\text{s}$) *TPAR* in both years i.e. 2014 and 2015 of *TPAR* than rest of Planting windows. This might be due to poor growth of crops resulted in low leaf area index.

Radiation Use Efficiency (RUE)

Effect of hybrids

The values of Radiation use efficiency were recorded higher (2.25 and 2.43 $\text{g MJ}^{-1}\text{m}^{-2}$) in both the years *i.e.* 2014 and 2015 in hybrids Phule Arjun than other two hybrids *viz.*, Krishna and Panchganaga. The lowest RUE values (1.85 and 1.86 $\text{g MJ}^{-1}\text{m}^{-2}$) in both the years *i.e.* 2014 and 2015 were recorded in hybrids Panchaganga.

Effect of planting windows

The planting windows at 31st MW recorded higher values of (2.28 and 2.46 $\text{g MJ}^{-1}\text{m}^{-2}$) radiation use efficiency and gradually decreased with delayed planting. The radiation use efficiency increased periodically from 28

DAT to 70 DAT. After 70 DAT, radiation use efficiency was declined up to final harvest. The planting windows at 34th MW recorded the lowest values of (2.02 and 1.92 g MJ⁻¹m⁻² radiation use efficiency than rest of the planting windows.

Determination of Growing Degree Days (GDD)

Effect of hybrids

The GDD in different hybrids varied from 35.41 to 72.3⁰C for emergence, 444.48 to 481.76⁰C days for vegetative growth, 512 to 575⁰C for 50 % flowering, 568.65 to 681.66⁰C days for first fruit setting and 1154.11⁰C to 1183.7⁰C days for final harvest. The highest values of GDD were recorded in hybrids Phule Arjun and the lowest values of GDD were recorded in hybrids Panchganaga.

Effect of planting windows

The GDD in different planting windows varied from 37.85 to 61⁰C for emergence, 452.2 to 484.6⁰C days for vegetative growth, 512.45 to 597.55⁰C for 50 % flowering, 611.05 to 658.66⁰C days for first fruit setting and 1128.85⁰C to 1183.2⁰C days for final harvest. The highest values of GDD were recorded in 31st MW planting windows and the lowest values of GDD were recorded in 34th MW planting windows. This might be due to delayed planting completed each phenophases earlier than the late planted crop.

Determination of Heliothermal Units (HTU)

Effect of hybrids

The HTU in different hybrids varies from (151.88 to 351.86) units for emergence, (1450.24 to 3539.83) units for vegetative growth, (1698.43 to

4357) units for 50 % flowering, (1893.69 to 4993.37) units for first fruit setting and (5282.36 to 9286.87) units for final harvest. The highest values of HTU were recorded in hybrids Phule Arjun and the lowest values of HTU were recorded in hybrids Panchganaga.

Effect of planting windows

The HTU in different planting windows varies from (93.96 to 411.98) for emergence, (1277.85 to 4044.66) units for vegetative growth, (1673.78 to 4770.45) units for 50 % flowering, (1852.04 to 3223.48) units for first fruit setting and (4899.03 to 10154.52) units for final harvest. The highest values of HTU were recorded at 31st MW planting window and the lowest values of HTU were recorded at 34th MW planting window. This might be due to delayed planting completed each phenophases earlier than the late planted crop.

Heat Use Efficiency (HUE)

Effect of hybrids

The values of heat use efficiency were recorded higher in (1.84 and 1.85 gm m⁻² day⁻¹) hybrids Phule Arjun than other two Hybrids *viz.*, Krishna and Panchganaga. The lowest heat use efficiency values were recorded in (1.66 and 1.67 gm m⁻² day⁻¹) hybrids Panchganga.

Effect of planting windows

The 31th MW planting windows recorded higher values of (1.83 and 1.79 gm m⁻² day⁻¹) heat use efficiency and gradually decreased with delayed planting. The heat use efficiency increased periodically from 28 DAT to 70 DAT. After 70 DAT, heat use efficiency was declined up to final harvest. The planting windows at 34th MW lower values recorded (1.58 and 1.60 gm m⁻² day⁻¹) in the heat use efficiency than rest of the planting windows.

Table 1: Incident PAR ($\mu\text{molm}^{-2}\text{s}^{-1}$) as influenced periodically by different treatments in 2014 and 2015.

| Treatment | Incident PAR | | | | | | | | | |
|--|--------------|-------|--------|-------|--------|-------|--------|-------|--------|-------|
| | 14 DAT | | 28 DAT | | 42 DAT | | 56 DAT | | 70 DAT | |
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A) Hybrids(H) | | | | | | | | | | |
| V₁:Phule Arjun | 1,066 | 1,175 | 1,223 | 1,335 | 1,270 | 1,373 | 1,201 | 1,322 | 1,108 | 1,209 |
| V₂: Krishna | 1,062 | 1,173 | 1,240 | 1,353 | 1,255 | 1,367 | 1,205 | 1,319 | 1,101 | 1,215 |
| V₃: Panchganga | 1,035 | 1,148 | 1,211 | 1,323 | 1,245 | 1,318 | 1,197 | 1,303 | 1,092 | 1,203 |
| B) Planting Windows(D) | | | | | | | | | | |
| P₁:31 MW (30 July– 5 August) | 1,110 | 1,222 | 1,320 | 1,381 | 1,302 | 1,377 | 1,226 | 1,393 | 1,160 | 1,274 |
| P₂:32 MW (6August 12August) | 1,072 | 1,183 | 1,250 | 1,363 | 1,292 | 1,362 | 1,219 | 1,347 | 1,098 | 1,269 |
| P₃:33MW (13August–19 August) | 1,015 | 1,124 | 1,156 | 1,292 | 1,269 | 1,358 | 1,187 | 1,300 | 1,076 | 1,208 |
| P₄:34MW(20August 2August) | 1,008 | 1,121 | 1,143 | 1,265 | 1,164 | 1,275 | 1,178 | 1,213 | 1,067 | 1,078 |
| General mean | 1,053 | 1,164 | 1,220 | 1,330 | 1,257 | 1,347 | 1,202 | 1,314 | 1,100 | 1,208 |

Table 1.continued..

| Treatments | 84 DAT | | 120DAT | | At harvest | |
|---|--------|-------|--------|------|------------|--------|
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A)Hybrids(H) | | | | | | |
| V ₁ :Phule Arjun | 980 | 1,057 | 1078 | 1100 | 932 | 934.59 |
| V ₂ :Krishna | 995 | 1,074 | 1095 | 1117 | 947 | 949.59 |
| V ₃ :Panchganga | 973 | 1,033 | 1054 | 1075 | 925 | 927.59 |
| Planting Windows(D) | | | | | | |
| P ₁ :31 MW (30July – 5 August) | 1,005 | 1,119 | 1130 | 1141 | 957 | 959.59 |
| P ₂ :32MW(6August–12August) | 990 | 1,102 | 1113 | 1124 | 942 | 944.59 |
| P ₃ :33MW(13August -19August | 967 | 1,081 | 1092 | 1103 | 919 | 921.59 |
| P ₄ :34MW(20August26August) | 943 | 949 | 958 | 968 | 895 | 897.59 |
| General mean | 979 | 1,059 | 1073 | 1084 | 931 | 934 |

Table 2: Absorbed PAR ($\mu\text{molm}^{-2}\text{s}^{-1}$) as influenced periodically by different treatments in 2014 and 2015

| Treatment | Accumulated absorbed PAR | | | | | | | | | |
|---|--------------------------|--------|--------|---------|--------|---------|--------|---------|--------|--------|
| | 14 DAT | | 28 DAT | | 42 DAT | | 56 DAT | | 70 DAT | |
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A) Hybrids | | | | | | | | | | |
| V ₁ : Phule Arjun | 799.5 | 881.25 | 917.25 | 1001.25 | 952.50 | 1029.75 | 900.75 | 991.50 | 831.00 | 906.75 |
| V ₂ : Krishna | 796.50 | 879.75 | 930.00 | 1014.75 | 941.25 | 1025.25 | 903.75 | 989.25 | 825.75 | 911.25 |
| V ₃ : Panchganga | 776.2 | 861.00 | 908.25 | 992.25 | 933.75 | 988.50 | 897.75 | 977.25 | 819.00 | 902.25 |
| B) Planting Windows | | | | | | | | | | |
| P ₁ : 31 MW (30 July–5 August) | 832.50 | 916.50 | 990.00 | 1035.75 | 976.5 | 1032.75 | 919.50 | 1044.75 | 870.00 | 955.50 |
| P ₂ : 32 MW (6 August–12 August) | 804.00 | 887.25 | 937.50 | 1022.25 | 969.00 | 1021.50 | 914.25 | 1010.25 | 823.50 | 951.75 |
| P ₃ : 33 MW (13 August–19 August) | 761.25 | 843.00 | 867.00 | 969.00 | 951.75 | 1018.50 | 890.25 | 975.00 | 807.00 | 906.00 |
| P ₄ : 34 M (20 August–2 August) | 756.00 | 840.75 | 857.25 | 948.75 | 873.00 | 956.25 | 883.50 | 909.75 | 800.25 | 808.50 |
| General mean | 789.42 | 872.78 | 915.32 | 997.70 | 942.53 | 1010.35 | 901.39 | 985.39 | 825.21 | 906.00 |

Table 2.continued..

| Treatments | 84 DAT | | 120DAT | | At harvest | |
|---|--------|--------|--------|--------|------------|--------|
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A)Hybrids(H) | | | | | | |
| V ₁ :Phule Arjun | 735.00 | 792.75 | 808.61 | 824.78 | 700.94 | 525.71 |
| V ₂ :Krishna | 746.25 | 805.50 | 821.61 | 838.04 | 712.19 | 534.14 |
| V ₃ :Panchganga | 729.75 | 774.75 | 790.25 | 806.05 | 695.69 | 521.77 |
| B) Planting Windows | | | | | | |
| P ₁ :31 MW (30July – 5 August) | 753.75 | 839.25 | 864.43 | 890.36 | 719.69 | 539.77 |
| P ₂ :32MW(6August–12August) | 742.50 | 826.50 | 851.30 | 876.83 | 708.44 | 531.33 |
| P ₃ :33MW(13August -19August | 725.25 | 810.75 | 835.07 | 860.12 | 691.19 | 518.39 |
| P ₄ :34MW(20August26August) | 707.25 | 711.75 | 733.10 | 755.10 | 673.19 | 504.89 |
| General mean | 734.25 | 794.46 | 820.97 | 845.60 | 700.19 | 525.14 |

Table 3: Intercepted PAR ($\mu\text{molm}^{-2}\text{s}^{-1}$) as influenced periodically by different treatments in 2014 and 2015

| Treatment | Accumulated Intercepted PAR | | | | | | | | | | | | | | | |
|---|-----------------------------|-------|--------|-------|--------|-------|--------|-------|--------|-------|--------|-------|---------|-------|------------------|-------|
| | 14 DAT | | 28 DAT | | 42 DAT | | 56 DAT | | 70 DAT | | 84 DAT | | 120 DAT | | At final harvest | |
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A) Hybrids (H) | | | | | | | | | | | | | | | | |
| V ₁ : Phule Arjun | 45.14 | 45.35 | 67.22 | 73.25 | 84.72 | 84.36 | 86.47 | 89.62 | 73.22 | 74.63 | 57.24 | 52.01 | 53.05 | 54.11 | 40.7 | 41.91 |
| V ₂ : Krishna | 33.34 | 28.11 | 60.12 | 60.41 | 76.39 | 76.86 | 83.43 | 84.44 | 69.26 | 68.35 | 52.61 | 50.43 | 51.44 | 52.47 | 39.1 | 40.33 |
| V ₃ : Panchganga | 31.23 | 34.5 | 63.41 | 60.95 | 74.28 | 74.87 | 84.38 | 85.48 | 67.18 | 69.01 | 51.72 | 60.53 | 61.74 | 62.98 | 49.2 | 50.43 |
| B) Planting Windows (D) | | | | | | | | | | | | | | | | |
| P ₁ : 31 MW (30 July – 5 August) | 57.48 | 59.3 | 72.29 | 74.28 | 83.1 | 85.91 | 87.13 | 91.81 | 75.41 | 76.06 | 58.85 | 61.41 | 62.64 | 63.89 | 50.1 | 51.31 |
| P ₂ : 32 MW (6 August – 12 August) | 42.05 | 44.09 | 66.31 | 66.63 | 79.52 | 80.68 | 85.52 | 88.42 | 71.59 | 74.83 | 55.47 | 57.92 | 59.08 | 60.26 | 46.6 | 47.82 |
| P ₃ : 33 MW (13 August – 19 August) | 31.12 | 32.59 | 63.11 | 65.27 | 76.27 | 78.45 | 84.67 | 86.59 | 67.32 | 69.19 | 53.52 | 54.63 | 55.72 | 56.84 | 43.3 | 44.53 |
| P ₄ : 34 M (20 August – 2 August) | 22.51 | 23.43 | 60.13 | 62.25 | 72.98 | 73.42 | 80.54 | 83.38 | 65.12 | 67.21 | 48.31 | 51.12 | 52.14 | 53.19 | 39.8 | 41.02 |
| General mean | 38.29 | 39.85 | 65.46 | 67.11 | 77.97 | 79.62 | 84.47 | 87.55 | 69.86 | 71.82 | 54.04 | 56.27 | 57.40 | 58.54 | 44.9 | 46.17 |

Table 4. Reflected PAR ($\mu\text{molm}^{-2}\text{s}^{-1}$) as influenced periodically different by treatments in 2014 and 2015

| Treatment | | | | | | | | | | | | | | | | |
|---|--------|-------|--------|------|--------|------|--------|-------|--------|------|--------|------|---------|------|------------------|-------|
| | 14 DAT | | 28 DAT | | 42 DAT | | 56 DAT | | 70 DAT | | 84 DAT | | 120 DAT | | At final harvest | |
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2015 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A) Hybrids(H) | | | | | | | | | | | | | | | | |
| V ₁ : Phule Arjun | 23.35 | 25.73 | 26.8 | 29.2 | 27.8 | 30.1 | 26.3 | 29.0 | 24.3 | 26.5 | 21.5 | 23.2 | 23.6 | 24.0 | 20.47 | 15.35 |
| V ₂ : Krishna | 23.26 | 25.69 | 27.2 | 29.6 | 27.5 | 29.9 | 26.4 | 28.9 | 24.1 | 26.6 | 21.8 | 23.5 | 23.9 | 24.4 | 20.80 | 15.60 |
| V ₃ : Panchganga | 22.67 | 25.14 | 26.5 | 28.9 | 27.2 | 28.8 | 26.2 | 28.54 | 23.9 | 26.3 | 21.3 | 22.6 | 23.0 | 23.5 | 20.31 | 15.24 |
| B) Planting Windows(D) | | | | | | | | | | | | | | | | |
| P ₁ :31 MW (30 July– 5 August) | 24.31 | 26.76 | 28.9 | 30.2 | 28.5 | 30.1 | 26.8 | 30.51 | 25.4 | 27.9 | 22.0 | 24.5 | 25.0 | 25.5 | 21.02 | 15.76 |
| P ₂ :32 MW (6August 12August) | 23.48 | 25.91 | 27.3 | 29.8 | 28.2 | 29.8 | 26.7 | 29.50 | 24.0 | 27.7 | 21.6 | 24.1 | 24.6 | 25.1 | 20.69 | 15.51 |
| P ₃ :33MW (13August –19 August) | 22.23 | 24.62 | 25.3 | 28.2 | 27.7 | 29.7 | 26.0 | 28.47 | 23.5 | 26.4 | 21.1 | 23.6 | 24.1 | 24.6 | 20.18 | 15.14 |
| P ₄ :34M (20August 2August) | 22.08 | 24.55 | 25.0 | 27.7 | 25.4 | 27.9 | 25.8 | 26.56 | 23.3 | 23.6 | 20.6 | 20.7 | 21.2 | 21.6 | 19.66 | 14.74 |
| General mean | 23.05 | 25.49 | 26.7 | 29.1 | 27.5 | 29.5 | 26.3 | 28.77 | 24.1 | 26.4 | 21.4 | 23.2 | 23.7 | 24.2 | 20.45 | 15.33 |

Table 5: Canopy temperature ($^{\circ}\text{C}$) regime of brinjal as influenced periodically by different treatments in 2014 and 2015

| Treatment | | | | | | | | | | | | | | | | |
|--|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|---------|------|------------------|------|
| | 14 DAT | | 28 DAT | | 42 DAT | | 56 DAT | | 70 DAT | | 84 DAT | | 120 DAT | | At final harvest | |
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2014 | 2015 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A)Hybrids(H) | | | | | | | | | | | | | | | | |
| V ₁ :Phule Arjun | 18.1 | 19.3 | 18.7 | 20.0 | 18.3 | 19.5 | 20.3 | 21.6 | 21.9 | 23.1 | 24.3 | 25.6 | 26.1 | 26.6 | 24.9 | 25.8 |
| V ₂ : Krishna | 19.0 | 20.2 | 19.6 | 20.9 | 18.7 | 19.9 | 21.3 | 22.6 | 22.5 | 24.4 | 25.5 | 26.8 | 27.3 | 27.9 | 26.1 | 26.9 |
| V ₃ : Panchganga | 19.2 | 20.5 | 20.6 | 21.9 | 20.4 | 21.7 | 22.6 | 23.9 | 24.3 | 25.6 | 26.6 | 27.8 | 28.4 | 29.0 | 27.1 | 28.0 |
| B) Planting Windows(D) | | | | | | | | | | | | | | | | |
| P ₁ :31 MW (30 July– 5 August) | 18.0 | 19.4 | 19.8 | 21.1 | 19.0 | 20.2 | 20.4 | 23.7 | 23.3 | 24.1 | 25.1 | 26.3 | 26.9 | 27.4 | 25.6 | 26.5 |
| P ₂ :32 MW (6August 12August) | 19.1 | 20.4 | 20.5 | 21.8 | 20.3 | 21.6 | 21.6 | 23.9 | 23.3 | 24.7 | 26.3 | 27.6 | 28.1 | 28.7 | 26.9 | 27.8 |
| P ₃ :33MW (13August –19 August) | 19.0 | 20.3 | 19.6 | 20.9 | 19.3 | 20.5 | 21.9 | 23.2 | 23.1 | 24.5 | 26.2 | 27.5 | 28.0 | 28.6 | 26.8 | 27.6 |
| P ₄ :34M (20August 2August) | 18.3 | 19.6 | 19.7 | 21.7 | 19.4 | 20.7 | 21.8 | 24.3 | 23.0 | 25.1 | 26.2 | 27.3 | 27.9 | 28.4 | 26.7 | 27.6 |
| General mean | 18.8 | 20.1 | 19.8 | 21.2 | 19.5 | 20.7 | 21.7 | 23.5 | 23.1 | 24.6 | 25.7 | 26.9 | 27.5 | 28.1 | 26.3 | 27.2 |

Table 6: Transmitted PAR ($\mu\text{molm}^{-2}\text{s}^{-1}$) influenced periodically different by treatments in 2014 and 2015

| Treatment | Accumulated Transmitted PAR | | | | | | | | | |
|---|-----------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 14 DAT | | 28 DAT | | 42 DAT | | 56 DAT | | 70 DAT | |
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A) Hybrids(H) | | | | | | | | | | |
| V ₁ :Phule Arjun | 305.11 | 337.91 | 355.13 | 387.31 | 272.07 | 289.38 | 188.96 | 206.03 | 320.62 | 352.50 |
| V ₂ : Krishna | 309.06 | 341.57 | 359.37 | 391.69 | 273.15 | 294.71 | 189.59 | 207.29 | 321.93 | 354.25 |
| V ₃ : Panchganga | 309.65 | 341.86 | 356.89 | 389.06 | 274.78 | 295.37 | 189.28 | 207.53 | 322.96 | 353.38 |
| B) Planting Windows(D) | | | | | | | | | | |
| P ₁ :31 MW (30 July– 5 August) | 301.62 | 334.38 | 346.27 | 380.54 | 263.25 | 285.76 | 187.35 | 199.05 | 316.97 | 334.47 |
| P ₂ :32 MW (6August 12August) | 310.98 | 343.44 | 361.92 | 394.88 | 277.17 | 295.22 | 190.58 | 209.61 | 321.51 | 362.41 |
| P ₃ :33MW (13August –19 August) | 302.64 | 334.82 | 348.17 | 384.49 | 274.67 | 294.79 | 188.06 | 205.91 | 318.29 | 353.49 |
| P ₄ :34M (20August 2August) | 316.53 | 349.15 | 372.16 | 397.51 | 278.26 | 296.85 | 191.13 | 213.23 | 330.57 | 363.14 |
| General mean | 307.94 | 340.45 | 357.13 | 389.35 | 273.33 | 293.15 | 189.28 | 206.95 | 321.84 | 353.38 |

Table 6 continued....

| Treatments | 84 DAT | | 120DAT | | At final harvest | |
|---|--------|--------|--------|--------|------------------|--------|
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A) Hybrids(H) | | | | | | |
| V ₁ :Phule Arjun | 285.08 | 306.50 | 312.63 | 318.88 | 272.07 | 289.38 |
| V ₂ :Krishna | 288.30 | 312.50 | 318.75 | 325.13 | 273.15 | 294.71 |
| V ₃ :Panchganga | 286.10 | 310.01 | 316.21 | 322.53 | 274.78 | 295.37 |
| B) Planting Windows(D) | | | | | | |
| P ₁ :31 MW (30July – 5 August) | 281.63 | 293.04 | 298.90 | 304.88 | 263.25 | 285.76 |
| P ₂ :32MW(6August–12August) | 288.50 | 315.41 | 321.72 | 328.15 | 277.17 | 295.22 |
| P ₃ :33MW(13August -19August | 285.14 | 312.34 | 318.59 | 324.96 | 274.67 | 294.79 |
| P ₄ :34MW(20August26August) | 290.70 | 317.90 | 324.26 | 330.74 | 278.26 | 296.85 |

Table 7: Radiation Use Efficiency ($\text{gmMJ}^{-1}\text{m}^{-2}$) of brinjal influenced periodically different by treatments in 2014 and 2015

| Treatment | | | | | | | | | | | | | | | | |
|---|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|---------|------|------------------|------|
| | 14 DAT | | 28 DAT | | 42 DAT | | 56 DAT | | 70 DAT | | 84 DAT | | 120 DAT | | At final harvest | |
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A)Hybrids(H) | | | | | | | | | | | | | | | | |
| V ₁ :Phule Arjun | 0.18 | 0.18 | 0.51 | 0.49 | 0.50 | 0.48 | 2.25 | 2.43 | 2.39 | 2.25 | 2.12 | 1.98 | 2.16 | 2.12 | 1.85 | 1.76 |
| V ₂ : Krishna | 0.10 | 0.12 | 0.21 | 0.24 | 0.41 | 0.41 | 2.18 | 2.33 | 2.27 | 2.14 | 1.94 | 1.82 | 1.98 | 1.94 | 1.78 | 1.69 |
| V ₃ : Panchganga | 0.06 | 0.08 | 0.15 | 0.18 | 0.35 | 0.35 | 2.13 | 2.26 | 2.15 | 2.03 | 1.82 | 1.72 | 1.86 | 1.82 | 1.70 | 1.64 |
| B)Planting windows(D) | | | | | | | | | | | | | | | | |
| P ₁ :31 MW (30 July– 5 August) | 0.12 | 0.13 | 0.32 | 0.34 | 0.46 | 0.45 | 2.28 | 2.46 | 2.35 | 2.21 | 2.01 | 1.85 | 2.05 | 1.95 | 1.83 | 1.76 |
| P ₂ :32 MW (6August -12August) | 0.12 | 0.13 | 0.30 | 0.31 | 0.44 | 0.43 | 2.23 | 2.41 | 2.25 | 2.07 | 1.93 | 1.80 | 1.97 | 1.87 | 1.77 | 1.70 |
| P ₃ :33MW (13August -19 August) | 0.12 | 0.13 | 0.29 | 0.30 | 0.42 | 0.41 | 2.12 | 2.29 | 2.26 | 2.11 | 1.91 | 1.79 | 1.95 | 1.85 | 1.76 | 1.68 |
| P ₄ :34M (20August -26August) | 0.09 | 0.11 | 0.26 | 0.27 | 0.37 | 0.37 | 2.12 | 2.18 | 2.22 | 2.19 | 1.98 | 1.91 | 2.02 | 1.92 | 1.74 | 1.64 |
| General mean | 0.11 | 0.13 | 0.29 | 0.31 | 0.42 | 0.41 | 2.19 | 2.34 | 2.27 | 2.14 | 1.96 | 1.84 | 2.00 | 1.90 | 1.78 | 1.70 |

Table 8: Cumulative growing degree days (GDD) of brinjal as influenced stage wise different by treatments in 2014 and 2015

| Treatment | EM | | VG | | 50% FL | | First FR | | At final harvest | |
|---|-------|-------|--------|--------|--------|--------|----------|--------|------------------|---------|
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A) Hybrids(H) | | | | | | | | | | |
| V ₁ :Phule Arjun | 59.6 | 72.3 | 481.76 | 478.3 | 575.5 | 568.65 | 681.66 | 645.7 | 1178.43 | 1183.7 |
| V ₂ : Krishna | 47.56 | 47.63 | 470.28 | 467.48 | 552.18 | 535.01 | 623.38 | 602.55 | 1166.28 | 1170.42 |
| V ₃ : Panchganga | 35.41 | 46.13 | 447.2 | 444.48 | 540.26 | 512.55 | 599.13 | 568.65 | 1154.11 | 1157.22 |
| B) Planting Windows(D) | | | | | | | | | | |
| P ₁ :31 MW (30 July– 5 August) | 53.75 | 61 | 46.45 | 484.6 | 525.5 | 597.55 | 631.8 | 658.6 | 1135.55 | 1183.2 |
| P ₂ :32 MW (6August 12August) | 45.25 | 59.4 | 453.3 | 464.9 | 530.85 | 554.53 | 624.3 | 641.35 | 1143.25 | 1161.85 |
| P ₃ :33MW (13August –19 August) | 39.1 | 50.4 | 457.5 | 471.85 | 526.45 | 543.25 | 616.4 | 621 | 1128.95 | 1152.1 |
| P ₄ :34M (20August 2August) | 37.85 | 38.65 | 452.2 | 469.65 | 512.45 | 539.05 | 611.05 | 611.4 | 1129.65 | 1143.4 |
| General mean | 45.50 | 53.64 | 401.24 | 468.75 | 537.60 | 550.08 | 626.82 | 621.32 | 1148.03 | 1164.56 |

Table 9: Cumulative Heliothermal units (HTU) of brinjal as influenced stage wise by different treatments in 2014 and 2015

| Treatment | EM | | VG | | 50% FL | | First FR | | At final harvest | |
|---|---------|---------|---------|---------|---------|---------|----------|---------|------------------|----------|
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A) Hybrids(H) | | | | | | | | | | |
| V ₁ :Phule Arjun | 249.97 | 351.86 | 1544.45 | 3539.83 | 1893.69 | 4357.69 | 2142.17 | 4993.37 | 5376.94 | 9190.09 |
| V ₂ : Krishna | 161.48 | 195.88 | 1450.24 | 3247.27 | 1698.43 | 4047.63 | 1893.69 | 4555.53 | 5282.36 | 9286.87 |
| V ₃ : Panchganga | 15188. | 271.31 | 1508.33 | 3435.54 | 1763.81 | 4164.83 | 2014.88 | 4902.32 | 5370.95 | 9086.14 |
| B) Planting Windows | | | | | | | | | | |
| P ₁ :31 MW (30 July– 5 August) | 251.24 | 34.785 | 1628.53 | 1982.23 | 1930.74 | 2767.46 | 2333.667 | 4904.23 | 4899.03 | 9970.4 |
| P ₂ :32 MW (6August 12August) | 145.055 | 344.27 | 1277.85 | 3927.96 | 1673.78 | 4770.45 | 1852.04 | 5303.45 | 5027.52 | 10154.52 |
| P ₃ :33MW (13August –19 August) | 93.96 | 411.98 | 1553.68 | 4044.66 | 1684.69 | 4629.4 | 1915.68 | 5318.79 | 5587.88 | 10145.44 |
| P ₄ :34M (20August 2August) | 184.64 | 100.255 | 1353.01 | 3658.41 | 1695.25 | 4177.76 | 2058.23 | 3223.48 | 5989.48 | 6877.1 |
| General mean | 178.26 | 244.33 | 1473.73 | 3405.13 | 1762.91 | 4130.75 | 2030.05 | 4743.02 | 5362.02 | 9244.37 |

Table 10: Heat Use Efficiency ($\text{gmm}^{-2}\text{day}^{-1}$) of brinjal influenced periodically by different treatments in 2014 and 2015.

| Treatment | | | | | | | | | | | | | | | | |
|---|--------|------|--------|------|--------|------|--------|------|--------|------|--------|------|---------|------|------------------|------|
| | 14 DAT | | 28 DAT | | 42 DAT | | 56 DAT | | 70 DAT | | 84 DAT | | 120 DAT | | At final harvest | |
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2015 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| A)Hybrids (H) | | | | | | | | | | | | | | | | |
| V ₁ :Phule Arjun | 0.01 | 0.02 | 0.36 | 0.36 | 0.48 | 0.50 | 1.10 | 1.09 | 1.48 | 1.48 | 1.80 | 1.83 | 1.84 | 1.85 | 1.74 | 1.76 |
| V ₂ : Krishna | 0.00 | 0.01 | 0.10 | 0.13 | 0.24 | 0.27 | 0.82 | 0.84 | 1.19 | 1.16 | 1.47 | 1.50 | 1.56 | 1.56 | 1.45 | 1.44 |
| V ₃ : Panchganga | 0.01 | 0.01 | 0.13 | 0.16 | 0.29 | 0.32 | 0.87 | 0.91 | 1.26 | 1.26 | 1.58 | 1.61 | 1.66 | 1.67 | 1.56 | 1.55 |
| B)Planting windows(D) | | | | | | | | | | | | | | | | |
| P ₁ :31 MW (30 July– 5 August) | 0.01 | 0.01 | 0.23 | 0.25 | 0.39 | 0.42 | 1.04 | 1.02 | 1.40 | 1.39 | 1.70 | 1.71 | 1.83 | 1.79 | 1.68 | 1.68 |
| P ₂ :32 MW (6August 12August) | 0.01 | 0.01 | 0.20 | 0.22 | 0.35 | 0.38 | 0.95 | 0.96 | 1.33 | 1.31 | 1.61 | 1.62 | 1.72 | 1.71 | 1.59 | 1.59 |
| P ₃ :33MW (13Augu2st –19August) | 0.01 | 0.01 | 0.19 | 0.21 | 0.33 | 0.35 | 0.92 | 0.93 | 1.30 | 1.28 | 1.57 | 1.58 | 1.67 | 1.66 | 1.56 | 1.55 |
| P ₄ :34M (20August 2August) | 0.01 | 0.01 | 0.17 | 0.19 | 0.29 | 0.31 | 0.86 | 0.87 | 1.21 | 1.24 | 1.53 | 1.54 | 1.58 | 1.60 | 1.48 | 1.51 |
| General mean | 0.01 | 0.01 | 0.20 | 0.22 | 0.34 | 0.36 | 0.94 | 0.94 | 1.31 | 1.30 | 1.60 | 1.61 | 1.69 | 1.69 | 1.58 | 1.58 |

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