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# Yield and Correlation with Weather Parameters as affected by Transplanting Time and different Varieties of Paddy (*Oryza sativa* L.)

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**ABSTRACT: The most critical element impacting crop yield is when it is planted. The performance of a variety is totally dependent on when it is planted. The research of crop for transplanting time and different varieties in relation to meteorological conditions is very important for attaining increased paddy yield. The length of the panicle (22.3 cm), number of spikelets panicle$^{-1}$ (14), number of grain panicle$^{-1}$ (180), grain weight panicle$^{-1}$ (4.04 g), test weight (22.20 g), grain yield (52.90 q ha$^{-1}$) and straw yield (62.27 q ha$^{-1}$) of Kharif paddy were all improved by transplanting during the 28$^{th}$ MW. VDN-99-29 (Phule Samruddhi) had significantly higher yield attributing characters such as panicle length (23cm), number of spikelets panicle$^{-1}$ (15), number of grain panicle$^{-1}$ (189), grain weight panicle$^{-1}$ (4.23 g), test weight (22.31 g), grain yield (53.55 q ha$^{-1}$), grain yield (53.55 q ha$^{-1}$), grain yield (53.55 q ha$^{-1}$) and straw yield (53.55 (61.02 q ha$^{-1}$). Interactions between paddy kinds and transplanting time had a significant impact on yield characteristics. When the VDN-99-29 (Phule Samruddhi) paddy variety was transplanted during the 28$^{th}$ MW, it had a significant effect on panicle length (23.9 cm), number of spikelets panicle$^{-1}$ (19), number of grain panicle$^{-1}$ (225), grain weight panicle$^{-1}$ (5.25 g), test weight (23.50 g), grain yield (66.20 q ha$^{-1}$), and straw yield (76.35 q ha$^{-1}$). When compared to the $T_{max}$, or maximum temperature, bright sun hour, and growing degree days (GDD) during the crop growing period showed significant and negative correlation with yield and yield attributing characters, whereas $T_{min}$, or minimum temperature, RH-I and RH-II during the crop growing period showed significant and positive correlation with yield and yield attributing characters.**

**Keywords:** transplanting time, paddy varieties, weather parameters, yield attributing characters, yield, and correlation.

## INTRODUCTION

Paddy has been the staple meal for more than 60% of the world's population, supplying energy to around 40% of the world's population, and every third person on the planet consumes rice on a daily basis in some form or another (Virdia and Mehta, 2009). As a result, crop paddy (*Oryza sativa* L.) is a widely produced crop in tropical and subtropical locations around the world. Higher population growth, increasing affluence and changing dietary habits leads to increased global food demand. The United Nations/Food & Agricultural Organization predicts that world food production will need to rise by over 40% and 70% by 2030 & 2050, respectively. Yet globally, water is anticipated to become scarce and there is increasing competition for land, putting added pressure on agricultural output. Besides, climate change will affects the reliability of the food supply through different changed weather patterns and increased damages due to pests and diseases. The worldwide paddy production was 503.17 in 2020-21 million metric tonnes; China was the leading country with a production of 148.30 million metric tonnes followed by India with 120.00 million metric tonnes (Anonymous, 2021).

Rice is a basic food crop that is grown all over the world. A number of researchers from India and elsewhere have studied the impact of transplanting time and sowing date on rice crop development and productivity. The rice crop's transplanting and sowing times had a major effect over three seasons. For starters, it guarantees that vegetative development occurs during a period of appropriate temperatures and total sunlight hours. Second, when the minimum night temperatures are historically the warmest, as indicated by the appropriate transplanting and sowing times for each cultivar, the cold-sensitive phase begins. Finally, early transplanting and seeding ensures that grain filling occurs during the cooler fall months, resulting in good grain quality. According to the findings of many studies, the highest production potential of a rice crop is usually achieved when the crop is exposed to the most suitable temperature range, which can be adjusted by transplanting sowing at the optimum time. In all contexts, weather variability has lately been identified as one of the key factors driving inter-annual variability in crop growth and production. Temperature and strong sunlight hours, in addition to rainfall, have influenced crop growth and development, and yield responses of various species to different conditions can be extremely varied. The effect of changing sowing dates on temperature and photoperiod has a big impact on phasic development and dry matter partitioning (Patel *et al*., 2019). Rice transplanting can be postponed until July 5 for medium-duration cultivars and June 25 for long-duration cultivars without affecting yield or grain quality. Long-duration cultivars are better suited to delayed transplanting than medium-duration cultivars. Regardless of cultivar or date of transplanting, 30 day old seedlings produced considerably higher grain yield, ACWP, TCWP, and RCWP than 60 day old seedlings (Brar *et al*., 2012).

Early-transplanted photoperiod-sensitive rice cultivars suffering from lag vegetative phase during which they grow taller and produce more biomass, making them more susceptible to lodging during the grain-filling stage. As a result, altering the transplanting period permits the plants to benefit from natural growth conditions. According to Yoshida (1993), rice plants require a specified temperature for phenological reactions such panicle initiation, blossoming, panicle development from the flag leaf sheath, and maturity, and these responses are highly influenced by transplanted paddy planting dates. Furthermore, the genotypes' genetic variability and potentiality were displayed differently since they were planted at different times. The optimal time for transplanted *Kharif* paddy is in July, however due to a number of physical and socioeconomic factors, this can be postponed. Late planting exposes the reproductive phase and phonological events of the crop to an unfavourable temperature regime, resulting in spikelet sterility and limited plant development. Rice planting dates, on the other hand, vary by geography and genotype (Bruns and Abbas, 2006). Chowdhury *et al*., (2000) found that when rice is planted after the 10$^{th}$ of August transplanting, grain and straw yields are gradually affected. According to Islam (1986), the time interval between 15 July and 20 August was ideal for transplanting *Kharif* rice, particularly photosensitive cultivars. The development and yield of transplanted *Kharif* rice genotypes were impacted by transplanting date. The purpose of this research was to figure out when the optimal time was to plant four high-yielding varieties for the *Kharif* season.

## MATERIALS AND METHODS

**Study Site Details:** The experimental field soil had a clay loam texture, was average in reaction (pH 7.1), had electrical conductivity of 0.32 dS m$^{-1}$, and a medium organic carbon content (0.53 percent), and was low in available nitrogen (162.67 kg ha$^{-1}$), high in available phosphorus (29.56 kg ha$^{-1}$), and high in available potassium (29.56 kg ha$^{-1}$) (467.00 kg ha$^{-1}$). All of the treatments received the same amount of fertilizer from Urea-DAP briquettes and MOP as a base dose (100:50:50 kg N, $P_2O_5$, and $K_2O$ ha$^{-1}$). Weather data were recorded regularly on each day in every week during investigation and presented in Table 1.

**Experimental details:** The field experiment used a split-plot design with three replications. The 48 treatment combinations were produced by transplanting VDN-3-51-18 (Indrayani), VDN-99-29 (Phule Samruddhi), IET-13549 (Bhogawati), and RDN-99-1 (Phule Radha) at four distinct dates, namely the 26$^{th}$, 28$^{th}$, 30$^{th}$, and 32$^{nd}$ Meteorological Weeks (MW), respectively. 2.95 m × 2.15 m and 2.65 m × 1.35 m were the gross and net plot sizes, respectively. The spacing for transplanting was determined to be 15-25 cm × 15-25 cm. On the nursery bed, paddy seedlings were produced by spreading seeds in a row. The first, second, third and fourth sowings on the nursery bed took place on the 10$^{th}$, 25$^{th}$, 9$^{th}$, and 22$^{nd}$ of June, respectively, and seedlings were transplanted at a spacing of 15-25 cm x 15-25 cm.

**Yield attributing characters determination:** Five plants were chosen at random from each net plot to record yield observations. Pegs were placed near the chosen plants to label and tag them. These plants were used to track all yield measurements. In each net plot, the yield contributing factors of five observational plants were recorded and reported per plant.

**Statistical analysis:** Standard approaches described by Panse and Sukhamate (1967) were used to conduct statistical analysis of a split-plot design with three replications, four main plot treatments, and four sub-plot treatments.

## RESULT AND DISCUSSION

### I) Effect on yield attributing characters of paddy

### 1. Effect on length of panicle (cm)

**A. Effect of transplanting times.** The length of the panicle of paddy was recorded highest when transplanting during 28$^{th}$ MW (22.3cm) and significantly superior overall transplanting times (Table 2). Significantly the lowest was observed in 32$^{nd}$ MW (13.2 cm). Nazir (1994); Sharief *et al*., (2000); Mahmood *et al.*, (1995); Kabir *et al*., (2014) all came up with similar conclusions.

**B. Effect of varieties.** The length of the paddy panicle was much longer (23 cm) in Phule Samruddhi, which was comparable to Indrayani (22 cm). The panicle length was substantially shorter in the variation Phule Radha (12.3 cm) and presented in Table 2. The variance in panicle length amongst paddy types could be attributable to paddy varieties' innate genetic potential.

**C. Interaction effect.** The interaction effects of paddy varieties with different transplanting times were found significant for panicle length and presented in Table 3. The interaction between Phule Samruddhi paddy variety with transplanting time of 28$^{th}$ MW has recorded the highest panicle length (23.9 cm) than the rest of the treatment combinations. Overall, Phule Samruddhi variety recorded more panicle length in all the transplanting times as compared to Indrayani, Bhogawati and Phule Radha. The least panicle length was observed in Phule Radha when interacted with different transplanting times.

**D. Correlation between weather parameters and length of panicle.** Due to varietal characteristics and environmental conditions at the time, the variety Phule Samruddhi had the longest panicles (Table 4). In the cases of $T_{max}$ (r = -0.781**), GDD (r = -0.713**), and bright sunshine hour (r = -0.713**), there was a strong negative connection between meteorological factors and panicle length. $T_{min}$, RH-I, RH-II, and rainfall all had significant positive correlations of r = 0.767**, r = 0.737**, r = 0.784**, and r = 0.782**, respectively.

**Table 1: The weather meteorological data recorded weekly in the experiment duration from June 2013 to December 2013.**

| Monthand year | Met. Week | Period | Mean Temp. (°C) | | Relative humidity (%) | | Rainfall (mm) | Rainy day | Bright Sunshine (hrs day$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Max. | Min. | Morn. | Eve. | | | |
| June 2013 | 26 | 24-30 | 25.8 | 22.4 | 91 | 86 | 65 | 7 | 1.2 |
| July 2013 | 27 | 01-07 | 26.1 | 22.1 | 91 | 87 | 74 | 7 | 1.1 |
| | 28 | 08-14 | 24.1 | 21.5 | 91 | 91 | 118 | 7 | 1.3 |
| | 29 | 15-21 | 24.2 | 21.4 | 91 | 91 | 132 | 7 | 1.1 |
| | 30 | 22-28 | 24.1 | 21.0 | 91 | 91 | 152 | 7 | 0.8 |
| Aug 2013 | 31 | 29-04 | 24.5 | 21.2 | 91 | 88 | 101 | 7 | 1.5 |
| | 32 | 05-11 | 26.0 | 22.1 | 91 | 84 | 35 | 7 | 2.1 |
| | 33 | 12-18 | 26.0 | 21.4 | 91 | 84 | 41 | 7 | 1.8 |
| | 34 | 19-25 | 25.5 | 21.0 | 91 | 81 | 32 | 7 | 1.9 |
| | 35 | 26-01 | 27.1 | 21.2 | 91 | 83 | 08 | 1 | 5.6 |
| Sept 2013 | 36 | 02-08 | 28.5 | 20.8 | 91 | 83 | 11 | 1 | 3.3 |
| | 37 | 09-15 | 29.5 | 21.7 | 91 | 74 | 107 | 7 | 1.4 |
| | 38 | 16-22 | 27.0 | 21.4 | 91 | 83 | 29 | 7 | 1.4 |
| | 39 | 23-29 | 26.2 | 21.1 | 91 | 84 | 09 | 1 | 2.6 |
| Oct 2013 | 40 | 30-06 | 28.5 | 21.1 | 91 | 72 | 17 | 1 | 1.8 |
| | 41 | 07-13 | 28.0 | 19.7 | 91 | 75 | 0 | 0 | 7.7 |
| | 42 | 14-20 | 29.5 | 21.0 | 91 | 67 | 01 | 0 | 8.4 |
| | 43 | 21-27 | 31.0 | 19.8 | 91 | 81 | 75 | 7 | 4 |
| | 44 | 28-03 | 30.4 | 17.5 | 86 | 75 | 0 | 0 | 6.6 |
| Nov 2013 | 45 | 04-10 | 30.2 | 16.8 | 87 | 73 | 0 | 0 | 9 |
| | 46 | 11-17 | 29.7 | 15.4 | 83 | 61 | 0 | 0 | 8.9 |
| | 47 | 18-24 | 31.4 | 17.2 | 90 | 71 | 0 | 0 | 8.8 |
| | 48 | 25-01 | 29.5 | 19.5 | 90 | 75 | 0 | 0 | 8 |
| Dec 2013 | 49 | 02-08 | 30.2 | 16.2 | 89 | 70 | 0 | 0 | 8.5 |

## 2. Number of spikelets panicle$^{-1}$

**A. Effect of transplanting times.** Different transplanting timings had a substantial impact on the amount of spikelets panicle$^{-1}$ in paddy and given Table 2. When paddy was transplanted at the 28$^{th}$ MW, the number of spikelets panicle$^{-1}$ was highest (14) and significantly higher than the other transplanting dates.

The 26$^{th}$ MW transplantation phase yielded significantly more spikelets than the 30$^{th}$ and 32$^{nd}$ MW transplantation periods. The change in the quantity of spikelets panicle$^{-1}$ caused by different transplanting times could be linked to altering climatic circumstances that affected the spikelets panicle$^{-1}$. These results corroborate with the finding of Nazir (1994); Sharief *et al*., (2000); Mahmood *et al*., (1995).

**B. Effect of varieties.** The observed in variety Phule Samruddhi significantly higher numbers of spikelets panicle$^{-1}$ (15) while in the case of Phule Radha variety significantly lower numbers of spikelets panicle$^{-1}$ (07) (Table 2). However, Suryavanshi (2015); Shende *et al.*, (2020) have previously reported similar findings.

**C. Interaction effect.** For the number of spikelets panicle$^{-1}$, there were significant interaction effects between transplanting times and paddy varieties and presented in Table 3.

In terms of the number of spikelets panicle$^{-1}$, the paddy variety Phule Samruddhi transplanted at different dates had considerably higher values (17, 19, 14 and 10 spikelets panicle$^{-1}$, respectively) than the other treatments. When the variety Phule Radha was transplanted, the number of spikelets panicle$^{-1}$ was the smallest (7, 8, 7 and 5 spikelets panicle$^{-1}$, respectively).

**D. Correlation between weather parameters and number of spikelets panicle$^{-1}$.** The diversity due to varietal characteristics and weather conditions at the time, Phule Samruddhi had the most spikelets panicle$^{-1}$ (Table 4). In the cases of $T_{max}$ (r = -0.684**), GDD (r = -0.532*), and bright sunshine hours (r = -0.666**), there was a strong negative connection between meteorological parameters and the number of spikelets panicle$^{-1}$. $T_{min}$, RH-I, RH-II, and rainfall all had significant positive correlations of r = 0.640**, r = 0.590*, r = 0.698**, and r = 0.699**, respectively.

## 3. Number of grains panicle$^{-1}$

**A. Effect of transplanting times.** The amount of grains panicle$^{-1}$ was significantly affected by the varied paddy transplanting timings and presented in Table 2. When paddy seedlings were transplanted at the 28$^{th}$ MW, the highest number of grains panicle$^{-1}$ (180) was recorded, which was significantly better than 26$^{th}$ MW transplanting timings. Diverse transplanting timings may have exposed the rice crop to different climatic conditions, producing obstruction in grain filling in paddy types' spikelets, resulting in a decrease in the quantity of grains panicle$^{-1}$. Nazir (1994); Sharief *et al.*, (2000); Mahmood *et al.*, (1995), respectively, found similar results.

**Table 2: The paddy yield attributing characters and yield at harvest as affected by different treatments.**

| Treatments | Length of panicle (cm) | Number of spikelets panicle$^{-1}$ | Number of grains panicle$^{-1}$ | Grain weight panicle$^{-1}$ | Test weight (g) | Grain yield (q ha$^{-1}$) | Straw yield (q ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| **Main plot: Transplanting times** | | | | | | | |
| **$T_1$:** 4$^{th}$ week of June (26$^{th}$ MW) | 19.8 | 12 | 178 | 3.87 | 21.45 | 49.58 | 55.33 |
| **$T_2$:** 2$^{nd}$ week of July (28$^{th}$ MW) | 22.3 | 14 | 180 | 4.04 | 22.20 | 52.90 | 62.27 |
| **$T_3$:**4$^{th}$ week of July (30$^{th}$ MW) | 18.9 | 11 | 139 | 2.92 | 20.87 | 38.48 | 48.06 |
| **$T_4$:** 2$^{nd}$ week of Aug (32$^{nd}$ MW) | 13.2 | 7 | 106 | 2.22 | 20.57 | 29.39 | 33.36 |
| S. Em± | 0.38 | 0.23 | 3.21 | 0.13 | 0.72 | 0.89 | 0.98 |
| C. D. at 5% | 1.33 | 0.81 | 11.33 | 0.47 | NS | 3.17 | 3.43 |
| **Subplot: Paddy varieties** | | | | | | | |
| **$V_1$:** VDN-3-51-18 (Indrayani) | 22.0 | 13 | 168 | 3.79 | 21.09 | 47.62 | 57.02 |
| **$V_2$:** VDN-99-29 (Phule Samruddhi) | 23.0 | 15 | 189 | 4.23 | 22.31 | 53.55 | 61.02 |
| **$V_3$:** IET-13549 (Bhogawati) | 16.0 | 9 | 146 | 3.04 | 20.47 | 41.35 | 45.03 |
| **$V_4$:** RDN-99-1 (Phule Radha) | 12.3 | 7 | 98 | 2.00 | 20.17 | 27.84 | 35.95 |
| S. Em± | 0.76 | 0.22 | 3.19 | 0.15 | 0.60 | 0.90 | 1.15 |
| C. D. at 5% | 2.20 | 0.66 | 9.36 | 0.43 | 1.76 | 2.64 | 3.39 |
| **General mean** | **18.6** | **11** | **151** | **3.0** | **21** | **42.59** | **49.75** |

**B. Effect of varieties.** The average number of grains panicle$^{-1}$ was significantly affected by the different types of paddy varieties and given in Table 2. Phule Samruddhi, a paddy variety, exhibited a significantly higher mean number of grains panicle$^{-1}$ (189). It was followed by Indrayani, Bhogawati and Phule Radha. This might be because of the genetic makeup of grain setting and development in the panicle.

**C. Interaction effect.** On the amount of grains panicle$^{-1}$, the interaction effects of paddy transplanting dates and varieties were significant and presented in Table 3. The paddy variety Phule Samruddhi was shown to have a significantly increased number of grains panicle$^{-1}$ when interacting with different transplanting periods (208, 225, 168 and 123 number of grains panicle$^{-1}$, respectively). It was statistically considerably superior to the other treatments, with the exception of transplanting variety Indrayani (203, 219, 178 and 108 number of grains panicle$^{-1}$, respectively). The second best interaction was the transplantation of the variety Bhogawati (153, 181, 131 and 88 number of grains panicle$^{-1}$, respectively). The transplanting of variety Phule Radha had the lowest (110, 132, 107, and 74) number of grains panicle$^{-1}$.

**D. Correlation between weather parameters and number of grains panicle$^{-1}$.** Due to varietal characteristics and weather conditions at the time, the variety Phule Samruddhi produced the most grains panicle$^{-1}$ (Table 4). In the cases of $T_{max}$ (r = -0.635**), GDD (r = -0.550*), and brilliant sunshine hour (r = -0.626**), there was a strong negative correlation between meteorological parameters and the number of grains panicle$^{-1}$. $T_{min}$, RH-I, RH-II, and rainfall all had significant positive correlations of r = 0.607**, r = 0.565*, r = 0.640**, and r = 0.644**, respectively.

**4. Grain weight panicle$^{-1}$**

**A. Effect of transplanting times.** The different transplanting times of paddy had significant effect on grain weight panicle$^{-1}$ and given in Table 2. The transplanting of paddy seedling at 28$^{th}$ MW recorded maximum grain weight panicle$^{-1}$ (4.04 g) which was significantly superior and it was at par with 26$^{th}$ MW transplanting times. The differences in grain weight panicle$^{-1}$ might be because of different transplanting times exposed the paddy crop to climatic conditions hence, obstruction in grain filling in spikelets of paddy varieties and adversely reflected it in grain weight panicle$^{-1}$. Nazir (1994), Sharief *et al*., (2000), and Mahmood *et al*., (1995) all came to similar conclusions.

**B. Effect of varieties.** The mean grain weight panicle$^{-1}$ (4.23 g) was found significantly higher in paddy variety Phule Samruddhi (Table 2). It was followed by Indrayani, Bhogawati and Phule Radha. This might be because of the genetic makeup for grain setting and development in a panicle (Shende *et al*., 2020).

**C. Interaction effect.** The interaction between paddy transplanting times and varieties had a substantial impact on the grain weight panicle$^{-1}$ and given in Table 3. The paddy variety Phule Samruddhi interacting with different transplanting times has recorded significantly higher grain weight panicle$^{-1}$ (4.90, 5.25, 3.93 and 2.84 g, respectively) and at par with Indrayani (4.58, 4.79, 3.34 and 2.44 g, respectively). It was significantly superior over Bhogawati (3.78, 3.54, 2.65 and 2.19 g) and Phule Radha (2.20, 2.60, 1.78 and 1.43 g).

**Table 3: Interaction effects on paddy yield attributing characters and yield at harvest.**

| Treatment combinations | length of panicle (cm) | Number of spikelets panicle$^{-1}$ | Number of grains panicle$^{-1}$ | Grain weight panicle$^{-1}$ | Test weight (g) | Grain yield (q ha$^{-1}$) | Straw yield (q ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| **$T_1V_1$** | 19.5 | 15 | 203 | 4.58 | 22.33 | 57.78 | 66.47 |
| **$T_1V_2$** | 22.8 | 16 | 208 | 4.90 | 21.97 | 59.63 | 70.09 |
| **$T_1V_3$** | 16.4 | 13 | 153 | 3.78 | 21.13 | 42.52 | 56.97 |
| **$T_1V_4$** | 13.2 | 8 | 110 | 2.20 | 20.37 | 30.52 | 34.56 |
| **$T_2V_1$** | 20.6 | 17 | 219 | 4.79 | 23.23 | 60.92 | 68.78 |
| **$T_2V_2$** | 23.9 | 19 | 225 | 5.25 | 23.50 | 66.20 | 76.35 |
| **$T_2V_3$** | 17.5 | 14 | 181 | 3.54 | 21.03 | 50.31 | 57.11 |
| **$T_2V_4$** | 14.2 | 10 | 132 | 2.60 | 21.03 | 36.75 | 41.82 |
| **$T_3V_1$** | 18.4 | 10 | 178 | 3.34 | 21.46 | 49.55 | 49.75 |
| **$T_3V_2$** | 22.7 | 12 | 168 | 3.93 | 21.83 | 49.52 | 58.90 |
| **$T_3V_3$** | 17.4 | 9 | 131 | 2.65 | 20.10 | 36.50 | 42.73 |
| **$T_3V_4$** | 12.5 | 6 | 107 | 1.78 | 20.10 | 29.79 | 28.75 |
| **$T_4V_1$** | 17.3 | 7 | 108 | 2.44 | 21.33 | 30.04 | 36.11 |
| **$T_4V_2$** | 21.6 | 8 | 123 | 2.84 | 21.93 | 36.25 | 43.75 |
| **$T_4V_3$** | 15.3 | 7 | 88 | 2.19 | 19.60 | 24.58 | 35.43 |
| **$T_4V_4$** | 12.4 | 5 | 74 | 1.43 | 19.17 | 20.48 | 28.30 |
| S. Em± | 0.76 | 0.46 | 6.42 | 0.23 | 1.24 | 1.80 | 1.95 |
| C. D. at 5% | 2.20 | 1.39 | 19.68 | 0.70 | 4.28 | 5.54 | 7.05 |
| **General mean** | **18.6** | **11** | **151** | **3.0** | **21** | **42.59** | **49.75** |

**D. Correlation between weather parameters and grain weight panicle$^{-1}$.** A variety Phule Samruddhi recorded maximum grain weight panicle$^{-1}$ due to varietal characters and weather conditions at that period, the correlation presented in Table 4. The correlation between weather parameters and grain weight panicle$^{-1}$ revealed significant negative correlation in case of $T_{max}$ (r = -0.606**), GDD (r = -0.509*) and bright sunshine hours (r = -0.595*). Significant positive correlation found with $T_{min}$, RH-I, RH-II, and rainfall and it was r = 0.576*, r = 0.536*, r = 0.613** and r = 0.614**, respectively.

**5. Test weight (g)**

**A. Effect of transplanting times.** Different paddy transplanting periods had no significant effect on the test weight of paddy as shown in Table 2. The considerably greater test weight was reported in paddy transplanting in the 28$^{th}$ MW (22.20 g), followed by paddy transplanting in the 26$^{th}$ MW (22.20 g) (21.45 g). The high temperature and high intensive rainfall particularly during panicle emergence and pollination cause bad effect on grain filling. Thus, the reduction in test weight was caused due to the smaller size of grains and chaffy grain. These findings matched those of Nazir (1994), Sharief *et al*., (2000), and Mahmood *et al*., (1995) respectively.

**B. Effect of varieties.** Different paddy varieties resulted in considerable differences in test weight and given in Table 2. Phule Samruddhi recorded significantly higher test weight (22.31 g) and at par with Indrayani (21.09 g) and significantly superior over the rest of the varieties.

**C. Interaction effect.** The interaction between paddy varieties and transplanting times were significant for thousand-grain weight and shown in Table 3. The transplanting of paddy variety Phule Samruddhi interacting with different transplanting times recorded significantly higher test weight (21.97, 23.50, 21.83 and 21.93 g, respectively). It was closely followed by Indrayani (22.33, 23.23, 21.46 and 21.33 g, respectively) and significantly the lowest test weight observed in variety Phule Radha (20.37, 21.03, 20.10 and 19.17 g, respectively).

**II) Effect on yield of paddy**

**1. Grain yield (q ha$^{-1}$)**

**A. Effect of transplanting times.** The impact of varying transplanting timings on paddy grain output was substantial and presented in Table 2. When paddy was transplanted at the 28$^{th}$ MW, the grain yield was at its peak (52.90 q ha$^{-1}$). Paddy seedlings transplanted at the 30$^{th}$ and 32$^{nd}$ MW yielded considerably reduced grain yields of 38.48 q ha$^{-1}$ and 29.39 q ha$^{-1}$, respectively. Nazir (1994); Sharief *et al*., (2000); Mahmood *et al*., (1995); Kabir *et al*., (2014) all reported similar findings.

**B. Effect of varieties.** Paddy grain yield (q ha$^{-1}$) was strongly influenced by cultivars and presented in Table 2. Phule Samruddhi had a much greater grain production (53.55 q ha$^{-1}$) than the other paddy types. The grain yield of the cultivar Phule Radha was substantially lower (27.84 q ha$^{-1}$). Differences in grain output between rice varieties could be related to paddy varieties' innate genetic potential. However, the findings are consistent with those previously published by Suryavanshi (2015) and Shende *et al*., (2020).

**C. Interaction effect.** When Phule Samruddhi was transplanted at the 26$^{th}$ MW, 28$^{th}$ MW, 30$^{th}$ MW, and 32$^{nd}$ MW, grain yields were considerably greater (60.92, 66.20, 50.31, and 36.75 q ha$^{-1}$, respectively) than the rest of the interactions (Table 3), with the exception of when variety Indrayani was transplanted at the 26$^{th}$ MW (57.98 q ha$^{-1}$). However, with transplanting times of 26$^{th}$ MW, 28$^{th}$ MW, 30$^{th}$ MW, and 32$^{nd}$ MW, interaction effects of paddy varieties

Indrayani, Phule Samruddhi, Bhogawati, and Phule Radha exhibited a decreasing trend in paddy grain production. This study found that paddy types that were transplanted later were unable to assimilate more biomass, resulting in lower paddy grain yields.

**Table 4: The Correlation between weather parameters and yield attributing characters and yield.**

| Weather parameter | Plant height (cm) | Number of tillers plant$^{-1}$ | length of panicle (cm) | Number of spikelets panicle$^{-1}$ | Number of grains panicle$^{-1}$ | Grain weight panicle$^{-1}$ | Test weight (g) | Grain yield (q ha$^{-1}$) | Straw yield (q ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| $T_{max}$ | -0.601** | -0.630** | -0.781** | -0.684** | -0.635** | -0.606** | -0.417 | -0.635** | -0.510* |
| $T_{min}$ | 0.583* | 0.586* | 0.767** | 0.640** | 0.607** | 0.576* | 0.381 | 0.600** | 0.467* |
| RH-I | 0.583* | 0.537* | 0.737* | 0.590* | 0.565* | 0.536* | 0.348 | 0.555* | 0.419* |
| RH-II | 0.564* | 0.643** | 0.784** | 0.698** | 0.640** | 0.613** | 0.431 | 0.643** | 0.522* |
| Rainfall | 0.580* | 0.645** | 0.782** | 0.699* | 0.644** | 0.614** | 0.429 | 0.646** | 0.526* |
| GDD | 0.304 | -0.483 | -0.713** | -0.532* | -0.550* | -0.509* | -0.286 | -0.524* | -0.380 |
| Bright sunshine hr. | -0.570* | -0.612** | -0.776 | -0666* | -0.626** | -0.595* | -0.400 | -0.622 | -0.494* |
| Canopy temperature | -0.250 | -0.380 | -0.263 | -0.384 | -0.364 | -0.355 | -0..198 | -0.371 | -0.418* |

* Significant at 5%    ** Significant at 1%

**D. Correlation between weather parameters and grain yield.** The variety Phule Samruddhi recorded maximum grain yield due to varietal characters and weather conditions during that period and correlation shown in Table 4. The correlation between weather parameters and grain yield revealed significant negative correlation in case of $T_{max}$ (r = -0.635**), GDD (r = -0.524*) and bright sunshine hour (r = -0.622**). Significant positive correlation found with $T_{min}$, RH-I, RH-II, and rainfall and it was r = 0.576*, r = 0.536*, r = 0.613** and r = 0.614**, respectively.

**2. Straw yield (q ha$^{-1}$)**

**A. Effect of transplanting times.** Different transplanting timings had a substantial impact on the mean straw yield of paddy and given in Table 2. At the 28th MW, the mean straw production (q ha$^{-1}$) was highest (62.27 q ha$^{-1}$), which was significantly higher than the rest of the transplanting times. The 26th MW was the second best transplanting period, with a much higher mean straw yield (55.33 q ha$^{-1}$) than the 30th and 32nd MW. Nazir (1994); Sherief *et al*., (2000); Mahmood *et al*., (1995) all came up with the same conclusions.

**B. Effect of varieties.** Paddy cultivars have a significant influence on paddy straw yield (q ha$_{-1}$) and presented in Table 2. The mean straw yield (q ha$^{-1}$) of Phule Samruddhi was much higher than the other rice cultivars (61.02 q ha$^{-1}$). The straw yield of the Phule Radha variety was significantly lower (35.95 q ha$^{-1}$). The genetic potential of paddy types could explain the variation in straw output among rice cultivars. Both Suryavanshi (2015); Shende *et al*., (2020) found comparable results.

**C. Interaction effect.** When Phule Samruddhi transplanted at 26th MW, 28th MW, 30th MW and 32nd MW have recorded significantly higher straw yield (68.78, 76.35, 57.11 and 41.82 q ha$^{-1}$, respectively) than rest of all interactions except it was at par with transplanting of variety Indrayani at 26th MW, 28th MW, 30th MW and 32nd MW having mean straw yield 66.47, 70.09, 56.97 and 34.56, respectively (Table 3). However, interactions effects between paddy varieties Indrayani, Phule Samruddhi, Bhogawati and Phule Radha with transplanting time 26th MW, 28th MW, 30th MW and 32nd MW showed decreasing trend in mean straw yield of paddy. These results showed that delay in transplanting of paddy varieties could not able to assimilate the more biomass as result reduced mean straw yield of paddy.

**D. Correlation between weather parameters and straw yield.** The variety Phule Samruddhi recorded maximum mean straw yield due to varietal characters and weather conditions during that period (Table 4). The correlation between weather parameters and straw yield revealed significant negative correlation in case of $T_{max}$ (r = -0.510*) and bright sunshine hour (r = -0.494*). Significant positive correlation found with $T_{min}$, RH-II, and rainfall and it was r = 0.467*, r = 0.522* and r = 0.526*, respectively.

## CONCLUSION

The transplanting period and diverse paddy types had a significant impact on paddy production and yield attributing attributes, according to the results of the experiment. After transplanting on the 28th MW, plant height, number of tillers plant$^{-1}$, panicle length, number of spikelets panicle$^{-1}$, number of grains panicle$^{-1}$, grain weight panicle$^{-1}$, test weight, grain, and straw production all increased significantly (2nd week of July). Phule Samurddhi was determined to be suited under Vadgaon-Maval conditions, with considerably greater panicle length, number of spikelets panicle$^{-1}$, number of grains panicle$^{-1}$, grain weight panicle$^{-1}$, test weight, grain, and straw yield. When compared to other transplanting times and kinds, the VDN-99-29 (Phule Samruddhi) paddy variety had a beneficial influence on test weight, grain and straw production, and yield attributing features when transplanted during the 28th MW (2nd week of July). On the 28th MW (2nd Week of July), Phule Samurddhi was transplanted, and it proved to be ideal and climatically acceptable for Vadgaon-Maval circumstances. During the crop growing period, $T_{max}$ (maximum temperature, bright sun hour, and growing degree days (GDD) showed a significant and negative correlation with yield and yield attributing characters, whereas $T_{min}$ (minimum temperature, RH-I, and RH-II) showed a significant and positive correlation with yield and yield attributing characters.

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