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Performance of summer paddy varieties under fertilizer levels in relation to weather parameters

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Abstract
The present investigation entitled "Performance of summer paddy varieties under fertilizer levels in relation to weather parameters" was carried out during *summer*, 2014 at Agricultural Research Station farm, Vadgaon Maval, Tal- Maval, Dist- Pune. The field experiment was laid out in a split plot design with three replications. There were sixteen treatment combinations comprising of four varieties VDN-3-51-18 (Indrayani), VDN-99-29 (Phule Samruddhi), IET-13549 (Bhogawati) and RDN-99-1 (Phule Radha) as main plot treatments and four fertilizer levels (F_1-75% RDF through straight fertilizers, F_2-100% RDF through straight fertilizers, $F_3$125% RDF through straight fertilizers and F_4-RDF through Urea DAP form(57:29:00)+50 KgK_2O)as sub plot treatments. The gross and net plot size were 2.95 m x 2.95 m and 2.55 m x 2.55 m, respectively. A spacing of 15-25 cm x 15-25 cm was adopted. Among the four different varieties of paddy, VDN-99-29 (Phule Samruddhi) recorded significantly higher growth and yield components resulted in increased yield as compared to VDN-3-51-18 (Indrayani), IET-13549 (Bhogawati) and RDN-99-1 (Phule Radha). It would be, therefore, suggested to adopt VDN-99-29 (Phule Samruddhi) variety for summer paddy cultivation under Vadgaon Mavalconditions. The application of fertilizer with 125% RDF through straight fertilizers favorably influenced all the growth and yield components which was at par with fertilizer through Urea DAP briquette form (57:27:00)+50 Kg K_2O ha^1 as compared to other fertilizer levels of paddy with 75%RDF through straight fertilizers,100%(100:50:50) through straight fertilizers. It would be, advisable either to apply 125% RDF through straight fertilizers or application of fertilizer through Urea DAP briquette form (57:29:00)+50KgK_2O ha^{-1} to summer paddy variety Phule Samruddhi. In summer season, VDN-99-29 (Phule Samruddhi) variety of paddy fertilized with either 125% RDF through straight fertilizers or application of fertilizer through Urea DAP briquette form (57:29:00)+50 Kg K_2O ha^{-1} favorably influenced growth and yield components as compared to other interactions formed due to varieties and fertilizer levels.

Keywords: Summer, paddy, fertilizer, weather

Introduction
Rice feeds more people over a longer period of time than any other crop. Rice has been documented in the history books as a source of food and for tradition as well since 2500 B.C. Beginning in China and the surrounding areas, its cultivation spread throughout Sri Lanka and India. It was then passed into Greece and areas of the Mediterranean. Rice spread throughout Southern Europe and to some part of North Africa. From Europe rice was brought to the New World. From Portugal it was brought into Brazil and from Spain to Central and South America.

Rice belongs to the genus *Oryza* and family *Poaceae*. It has two cultivated and 22 wild species. The cultivated species are *Oryza sativa* and *Oryza glaberrima*. *Oryza sativa* is grown all over the world while *Oryza glaberrima* has been cultivated in West Africa for the last 3500 years.

The green revolution has helped the country to regional food surpluses with Punjab leading the country in rice production and productivity. However, despite the past achievements, rice productivity growth has to continue for obvious reasons. Looking to the future, Indian rice production will come under additional pressure from intense competition for land and water, a more difficult growing environment because of climate change, higher price for energy and fertilizers and greater demand for reduced environment footprint. This requires a careful analysis of the current production scenario and perspectives with a view to identify researchable issues and strategies to address them.

In summer paddy, among the various cultural practices selection of proper variety, date of planting, plant fv. Balanced fertilizer application is the most important factor in influencing the yield of crop. Performance of genotype entirely depends up on the fertilizer management. Unbalanced fertilizer management to genotypes results in yield reduction which can't be

compensated by any other means (Dixit and Patro, 1994) [1] reported the same. For obtaining the higher summer paddy production study of crop in relation to weather condition and pest and diseases infestation is very necessary. As 2 ^{0}C increase in air temperature could decreased rice yield by about 0.75 tons ha^{-1} in high yielding area. There is 5% decrease in rice yield for every 1 ^{0}C rise in temperature above 32 ^{0}C. Attack of pest and disease is totally depends on weather condition and host abundance (Khan and Ram Murthy, 2004) [5] have reported that, minimum temperature and rainfall had significant effect on leaf folder population structure in paddy.

In view of this, present investigation entitled " Performance of summer paddy varieties under fertilizer levels in relation to weather parameters was undertaken with following objectives:

1. To find out suitable summer paddy variety in relation to weather parameters.
2. To find out suitable fertilizer level in relation to weather parameters.

The present field investigation was carried out to study "Performance of summer paddy varieties under fertilizer levels in relation to weather parameters." The relevant details of material used and methods adopted in conducting the present field investigation are presented in this chapter.

Material and methods

Experimental site

The field experiment was conducted during *summer*, 2014 at Agricultural Research Station Farm, Vadgaon Maval, Tal. Maval, Dist. Pune.

Soil

The topography of the experimental field was uniform and leveled. The soil was clay loam in texture with a depth upto60 cm.

Details of experimental method

Experimental detail

The experiment was laid out in split plot with sixteen treatment combinations and three replications. The four paddy varieties *viz*.,V_1: VDN-3-51-18 (Indrayani), V_2: VDN-99-29 (Phule Samruddhi), V_3: IET-13549 (Bhogawati), V_4: RDN-99-1 (Phule Radha)as main plot treatment and four fertilizer levels *viz*., 75% RDF through straight fertilizer, 100% RDF (100:50:500) through straight fertilizer,125%RDF through straight fertilizer and fertilizer through Urea DAP briquette (57:29:00) form+50Kg K_2O ha^{-1} as sub plot treatments. The gross plot size was 2.95 m x 2.95 m and net plot size was 2.55 m x 2.55 m. The details of experiment with symbols used are presented in Table 1 and plan of field layout along with allocation of treatments

Table 1: Details of treatment with their symbol

Sr. No.	Treatment Details	Symbol used
A.	**Main Plot treatments:Varieties(V)**	
1	VDN-3-51-18 (Indrayani)	V_1
2	VDN-99-29 (PhuleSamruddhi)	V_2
3	IET-13549 (Bhogawati)	V_3
4	RDN-99-1 (PhuleRadha)	V_4
B.	**Sub Plot treatments:fertilizer levels (F)**	
1	75% RDF through straight fertilizer	F_1
2	100%RDF (100:50:50) through straight fertilizer	F_2
3	125%RDF through straight fertilizer	F_3
4	Fertilizer through Urea DAP briquette form (59:29:00)+50Kg K_2O ha^{-1}	F_4

Table 2: Treatment combinations (16)

1	V1F1	5	V2F1	9	V3F1	13	V4F1
2	V1F2	6	V2F2	10	V3F2	14	V4F2
3	V1F3	7	V2F3	11	V3F3	15	V4F3
4	V1F4	8	V2F4	12	V3F4	16	V4F4

Table 3: Preparation of field layout

The plan of layout are given below and depicted in Fig.2.		**The other details of layout are given below:**
1.	Name of crop	Paddy
2.	Varieties	As per treatments
3.	Season	*Summer*, 2014
4.	Design	Split plot
5.	No. of Replications	Three
6.	Treatments	Sixteen (4x4)
7.	Spacing	15-25 cm x 15-25 cm
8.	Plot size	Gross: 2.95 m x 2.95 m Net: 2.55 m x 2.55 m
9.	Place of research work	A.R.S.farm, Vadgaon Maval, Tal. Maval, Dist. Pune.
10.	Commencement of research work	*Summer*, 2014
11.	Transplanting date	2/1/2014
12.	Fertilizer	100:50:50 NPK kg ha^{-1}

Sampling technique

For recording growth observations, five plants were selected randomly from each net plot. The selected plants were labeled and were marked by fixing pegs near them. All the observations on growth and yield were recorded on these plants.

Plant count
The initial and final plant count were recorded at 15th days after transplanting and at harvest from randomly selected three spots of one meter row length in every net plot and converted on hectare basis.

Growth studies
Plant height (cm)
The height of plant generally indicates the growth of crop. Five randomly selected plants from each net plot were used for recording the plant height. The periodical plant height was measured from ground level till to end in cm at 15th, 30th, 45th, 60th, 75th and 90th DAT of crop growth and at harvest.

Number of tillers (plant^{-1})
The total number of tillers from five randomly selected plants from each net plot was counted. The tillers were recorded on 30th, 45th, 60th, 75th and 90th days after transplanting and at harvest, respectively.

Meteorological observations
Growing Degree Day requirement
The GDD was computed by summing the daily mean temperature recorded during growing period by following formula

GDD = (Tmax+ Tmin) /2 –Base Temperature
Base temperature for paddy = 10 ^{0}C

Maximum temperature (^{0}C)
The maximum temperature was recorded with the help of maximum thermometer kept in Single Stevenson's screen from observatory.

Minimum temperature (^{0}C)
The minimum temperature was recorded with the help minimum thermometer kept in Single Stevenson's screen from observatory.

Humidity (%)
The humidity was recorded with the help of dry bulb and wet bulb thermometer kept i Single Stevenson's screen from observatory.

Bright sunshine (hrs.)
Bright sunshine hours were recorded with the help of bright campbell stokes sunshine recorder from observatory.

Canopy temperature (^{0}C)
The infrared thermometer was used to measure the canopy temperature remotely.

Theory of operation
It detects minute difference between crop canopy and surrounding air temperature. Telatemp (model AG-42) was used for measurement of canopy temperature and canopy-air temperature differential in this experiment.

Working principle
The energy flux emitted by an object is a function of its absolute temperature.
The infrared thermometer senses long wave radiation emitted by the object and converts this value to a temperature scale according to Stefan's Law:

$E = \varepsilon\sigma T^4$

Where,
E = Energy flux, Wm^{-2}
ε = Emmissitivity of the body
σ = Stefan Boltzman constant = (5.67×10^8 Wm^{-2} K^{-4}),
T= Absolute Temperature of the body, ^{0}K

Measuring temperature
To take temperature measurement, the instrument is held by grip, which promptly "come to life' as evidenced by the digital display.

Rainfall (mm)
Rainfall was recorded with the help of automatic type of rain gauge from observatory.

Post-harvest studies
The yield contributing characters were recorded periodically on five observational plants from each net plot and reported on per plant basis.

Harvesting and threshing
The crop from each net plot was harvested separately at maturity, labeled and tied in bundles according to treatments. The produce of each plot was threshed separately and weight of grain and straw taken separately

Length of panicle (cm)
The length of panicle was measured from basal to tip of the panicle excluding awns from five randomly selected plants. The mean length of panicle was worked out in cm.

Number of spike plant^{-1}
The number of spikes plant^{-1}were counted from the same panicle which was used for measuring the panicle length at harvest and average number of spikes plant^{-1} were worked out.

Number of grains spikes^{-1}
The grain number spikes^{-1}was counted from five randomly selected plants. The same panicle in each treatment which was used for recording length of panicle was used for counting number of grains spike^{1}.

Mean weight of grains spikes^{-1}(g)
The grains used for mean weight of grains spike^{-1} were used for recording the weight of grains spike^{-1}. The average was computed to obtain grain weight spike^{-1}.

Test weight (g)
The random samples of grain from total grain produced from each net plot were taken. Then thousand grains were counted and weighed to obtain test weight (g) from each treatment. One thousand grains from each sample were counted and its weight was recorded.

Yield studies
Grain yield (q ha^{-1})
Grain weight net plot^{-1} was recorded after threshing all plants of each net plot. The final grain yield from each net plot was obtained by adding grain weight of five observational plants of respective net plot. The treatment wise per ha grain yield was computed by multiplying hectare factor and calculated as grain yield hectare^{-1}.

Straw yield (q ha^{-1})
The straw yield net plot^{-1}was obtained by subtracting grain yield from biological yield of respective net plot. The straw yield per net plot was converted to hectare with multiplication of hectare factor.

Quality studies
Protein content (%)
Protein content of grain was determined by multiplying nitrogen content in grain by 6.25and recorded per cent protein.

Result & discussion
The detail results of investigation are presented and discussed in this chapter.

Plant count
Initial plant count
The data regarding the initial plant count at 15 days after transplanting per plot presented in Table 9.

The mean initial plant count plot^{-1} was 255. The initial plant count plot^{-1}did not affect significantly due to different varieties and different fertilizer levels of paddy. The interaction between varieties and fertilizer levels of paddy was not significant.

Final plant count
The data regarding the final plant count at harvest plot^{-1} was 250. The final plant count plot^{-1}did not affect significantly due to different varieties and different fertilizer levels of paddy. The interaction between varieties and fertilizer levels of paddy was not significant.

Growth studies
The biometric observations of paddy were recorded on growth characters *viz.*, plant height, number of tiller plant^{-1}at regular interval of 15, 30, 45, 60, 75, 90 days after transplanting and at harvest, respectively.

Table 4: Initial and final plant population plot^{-1} as influenced by varieties and fertilizer levels

Treatment	Initial plant count (at 15 DAT)	Final plant count (at harvest)
A.Main plot treatments: Varieties(V)		
V_1:VDN-3-51-18(Indrayani)	255	249
V_2:VDN-99-29(PhuleSamruddhi)	256	251
V_3:IET-13549(Bhogawati)	254	248
V_4:RDN-99-1(PhuleRadha)	253	246
S.E m±	2.02	2.19
C.D.at 5%	NS	NS
B.Sub plot treatments: Fertilizer levels (F)		
F_1:75% RDF through straight fertilizer	255	250
F_2:100%RDF(100:50:50)through straight fertilizer	255	252
F_3:125%RDF through straight fertilizer	256	253
F_4: Fertilizer through Urea-DAP briquette form (57:29:00)+50 Kg K_2O ha^{-1}	255	253
S.Em±	1.14	1.39
C.D.at 5%	NS	NS
C.Interaction(V×F)		
S.E.m±	1.65	1.03
C.D. at 5%	NS	NS
General mean	255	250

Effect of varieties
Different varieties of paddy showed a significant influence on growth parameters. plant height and number of tillers plant^{-1}were significantly more with the variety VDN-99-29 (Phule Samruddhi) and significantly superior over VDN-3-51-18 (Indrayani), IET-13549 (Bhogawati) and RDN-99-1 (Phule Radha).
The yield attributing characters *viz*., number of spike plant^{-1}, number of grains per spike, mean weight(g) of grains per spike, grain and straw yields (q/ha) were significantly more with the variety VDN-99-29 (Phule Samruddhi) and significantly superior over VDN-3-51-18 (Indrayani), IET-13549 (Bhogawati) and RDN-99-1 (Phule Radha). Length of panicle and test weight were significantly more with the variety VDN-99-29 (Phule Samruddhi) which was at par VDN-3-51-18 (Indrayani) and significantly superior over IET-13549 (Bhogawati) and RDN-99-1 (Phule Radha). Similar result for panicle length were reported by Ghille (1995) [3].
The gross monetary returns (Rs. 115480 ha^{-1}), net monetary returns (Rs 49449 ha^{-1}) and benefit: cost ratio were significantly more with the variety VDN-99-29 (Phule Samruddhi) and significantly superior over VDN-3-51-18 (Indrayani), IET-13549 (Bhogawati) and RDN-99-1 (Phule Radha).Similar results were found by Lai *et al.* (2004) [6].

Effect of fertilizer levels
The application of fertilizer to paddy during different fertilizer levels significantly influenced growth and yield parameters. Plant height was significantly more with the application of 125% RDF through straight fertilizers than rest of all levels except it was at par with fertilizer through Urea DAP briquette form (57:29:00)+50KgK_2O.Similar results were reported for seed test weight by Dubey (1993) [2], Ghille (1995) [3] and Dixit and Patro (1993). Number of tillers plant^{-1} was significantly more with the application of 125% RDF through straight fertilizers than rest of all the fertilizer levels. which was at par with fertilizer through Urea DAP briquette form (57:29:00)+50KgK_2O.
The yield attributing characters *viz*., length of panicle, number of grains spike plant^{-1}, test weight, grain and straw yields were significantly more with the application of 125% RDF through straight fertilizers than other fertilizer levels, but it was at par with application of fertilizer through Urea DAP briquette form (57:29:00)+50KgK_2O. Number of grains spike^{-1} and mean weight of grain spike^{-1} were significantly more. with the application of 125% RDF through straight fertilizers

than other fertilizer levels but it was at par with application of fertilizer through Urea DAP briquette form (57:29:00)+50KgK_2O.The gross monetary returns and net monetary returns (Rs ha^{-1}) and benefit: cost ratio were significantly more with the fertilizer through Urea DAP briquette form (57:29:00)+50 KgK_2O than rest of fertilizer levels, but it was at par with the application of 125% RDF through straight fertilizers.

Effect of interactions

The effect of interaction between paddy varieties and fertilizer levels were significant for plant height at all the stages, number of tillers $plant^{-1}$, length of panicle, number of grains spike $plant^{-1}$, mean weight (g) of grains per spikes, test weight, grain and straw yields. The lowest number of tillers (8) were observed with application of 75% RDF through straight fertilizers. Similar result was reported by Khalid Mehmood *et al.* (2003) [4]. It was mainly due to less leaching losses of fertilizers and there by increased fertilizer use efficency. The paddy variety Phule Samruddhi when applied 125% RDF through straight fertilizers exhibited significantly superior growth and yield attributes as well as grain and straw yields over rest of all the treatment except it was at par with application of fertilizer through Urea DAP briquette form (57:29:00)+50KgK_2O than rest of the combinations.

Table 6: Growing degree days (heat unit) for *summer* paddy as influenced periodically by varieties

.	VARIETIES							
DAT	**Indrayani**		**Phule Samruddhi**		**Bhogawati**		**PhuleRadha**	
	GDD	**Cumulative**	**GDD**	**Cumulative**	**GDD**	**Cumulative**	**GDD**	**Cumulative**
15	180.75	180.75	180.75	180.75	180.75	180.75	180.75	180.75
30	162	342.75	162	342.75	162	342.75	162	342.75
45	172.5	515.25	172.5	515.25	172.5	515.25	172.5	515.25
60	162	677.25	162	677.25	162	677.25	162	677.25
75	187.5	864.75	187.5	864.75	187.5	864.75	187.5	864.75
90	256.5	1121.25	256.5	1121.25	256.5	1121.25	256.5	1121.25
105	282	1403.25	282	1403.25	282	1403.25	282	1403.25
120	288	1691.25	288	1691.25	288	1691.25	-	-
135	333.8	2025.1	-	-	333.8	2025.1	-	-
Total	8821.6		6796.5		8821.6		5105.0	

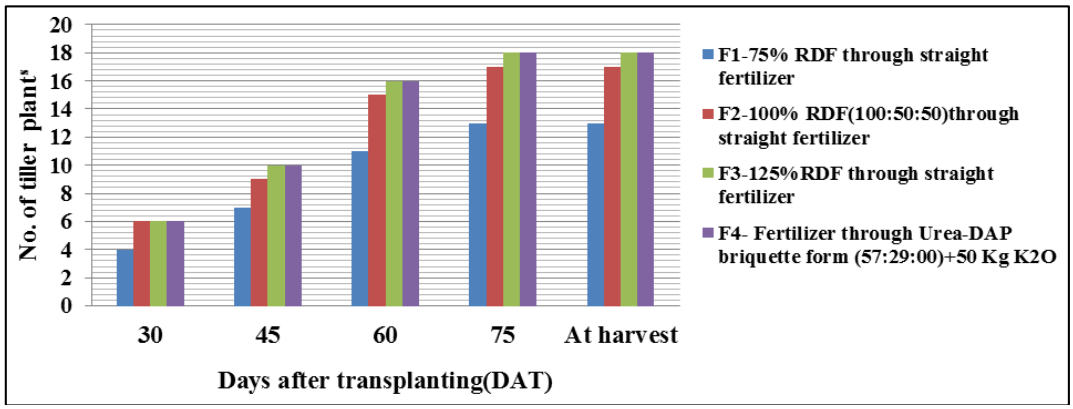

Fig 1: Total number of tillers $plant^{-1}$ as influenced periodically by varieties and fertilizer levels

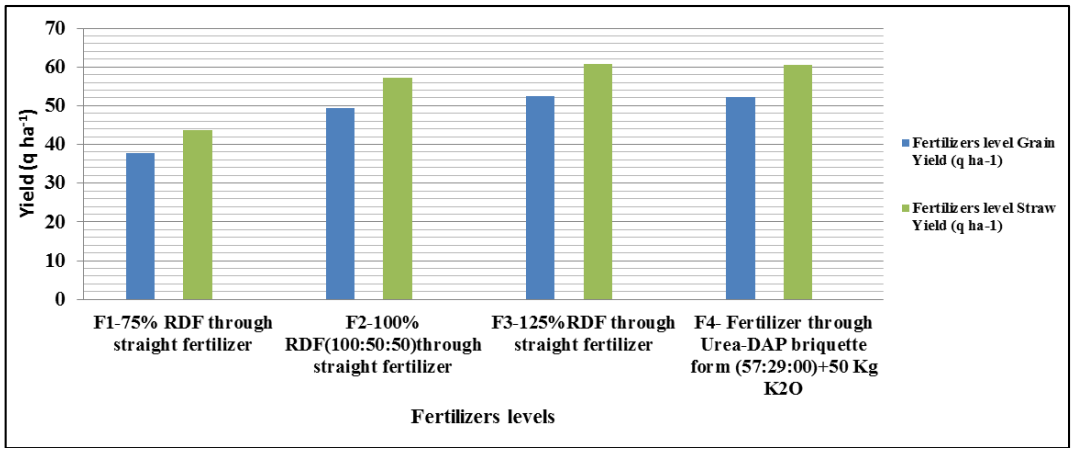

Fig 2: Grain and straw yields (q/ha) as influenced by varieties and fertilizer levels

Conclusions

Among the four different varieties of paddy, VDN-99-29 (Phule Samruddhi) recorded significantly higher growth and yield components resulted in increased yield as compared to VDN-3-51-18(Indrayani), IET-13549 (Bhogawati) and RDN-99-1 (Phule Radha). It would be, therefore, suggested to adopt VDN-99-29 (Phule Samruddhi) variety for summer paddy cultivation under Vadgaon Maval conditions. The application

of fertilizer with 125% RDF through straight fertilizers favorably influenced all the growth and yield components which was at par with fertilizer through Urea DAP briquette form (57:27:00)+50 Kg K_2O ha^{-1} as compared to other fertilizer levels of paddy with 75%RDF through straight fertilizers,100%(100:50:50) through straight fertilizers. It would be, advisable either to apply 125% RDF through straight fertilizers or application of fertilizer through Urea DAP briquette form (57:29:00)+50KgK_2O ha^{-1} to summer paddy variety Phule Samruddhi. In summer season, VDN-99-29 (Phule Samruddhi) variety of paddy fertilized with either 125% RDF through straight fertilizers or application of fertilizer through Urea DAP briquette form (57:29:00)+50 Kg K_2O ha^{-1} favorably influenced growth and yield components as compared to other interactions formed due to varieties and fertilizer levels.

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