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NEWS

TECHNICAL BULLETIN—A QUARTERLY HOUSE BULLETIN OF NATIONAL PHYSICAL LABORATORY

A special issue on the Birth Centenary of Professor C. V. Raman (7th November 1988) was released by Prof. D. S. Kothari, Chancellor, University of Delhi, Delhi, on 7th November 1988.

This special publication with colour photographs runs to fifty pages and contains a wealth of information for the young research workers and college students. Dr Krishan Lal, Deputy Director and Head, Materials Characterization Division, National Physical Laboratory, has written a preface 'a note on Professor C. V. Raman's Lecture on Fluorochromes'. He writes: "This lecture, obviously one of the last public lectures by Sir C. V. Raman, gives the flavour of the passion with which this great scientist pursued science all his life. It also gives a glimpse of some prominent facets of his great personality. He was deeply concerned with scientific education in the country, not only at higher levels but also at the grass-root level. His commitment to science, to truth, to the solid factural observations, is amply reflected all through. He extolled the fellow scientists to shed all lethargy and pursue science vigorously."

Individuals or Institutions interested in obtaining a copy (free of cost) may write to: Dr Krishan Lal, Deputy Director, National Physical Laboratory, New Delhi 110 012.

NOBEL PRIZES

Ten distinguished persons in the fields of Medicine, Economics, Physics, Chemistry and Literature were awarded the 1988 Nobel Prizes.

Three American professors, Leon Ledermann, Melvin Schwartz and Jack Steinberger shared the prize for Physics.

The prize for Chemistry went to three Federal German researchers, Johann Deisenhofer, Hartmut Michel and Robert Huber.

Sir James Black of Britain and Gertrude Elion of the United States won the prize for Medicine.

The prize for Economics was awarded to French economist Maurice Allais.

The winner of the literature prize is Nagib Mahfouz of Egypt.

The awards were presented by King Carl XVI Gustav of Sweden on Saturday the 10th December 1988.

The winners receive 2.5 million Swedish kroner each, diplomas, and gold medals bearing Nobel's image.

CLIMATIC CONSTRAINTS OF HIGH-YIELDING PHOTO-INSENSITIVE WINTER RICE IN KERALA

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ABSTRACT

Field experiments were conducted at the Regional Agricultural Research Station, Pattambi to identify the factors responsible for the low productivity of high-yielding varieties of rice raised during the winter seasons in Kerala. The experiment with seven planting dates and four popular high-yielding photo-insensitive rice varieties showed that the variations in rice yield between the different planting dates were primarily due to spikelet sterility under optimum package of practices. Correlation analysis between weather parameters and grain yield revealed the critical role of certain weather-components during the flowering and maturity stages of the crop in deciding the final yield. Preliminary prediction models were worked out for estimating grain yield under the adverse weather conditions. The effect of these adverse weather factors are discussed and future lines of work suggested.

INTRODUCTION

For increasing the production of rice, a high-yielding variety programme was launched in Kerala during 1972 with the introduction of a few high-yielding photo-insensitive dwarf indica varieties such as TN-1, IR-8, Jaya and Annapoorna. In the years that followed several other varieties were also evolved and released for cultivation in the state. These varieties had the advantage of a very high grain production potential, i.e., three to four times the yield of local tall varieties, under optimum conditions. They also had a wide range of adaptability. But ever since their introduction, farmers, research workers and extension personnel have been facing the problem of their low productivity during certain seasons, mostly during the winter (September to January) season of Kerala. This low productivity was attributed to the high degree of spikelet sterility. This high degree of spikelet sterility during certain winter seasons was neither due to water deficiency nor due to pests or disease problems. Occasionally yields as low as 700 to 1500 kg/ha or even lower were observed in the rice fields of the Regional Agricultural Research Station, Pattambi[1]. Hence a comprehensive study was planned and conducted at the Regional Agricultural Research Station, Pattambi, the results of which are reported in this paper.

EXPERIMENTAL

Field experiments were conducted at the sandy clay loam alfisols from 1983–84 winter season and three subsequent winter seasons. The objective of the experiment was to identify the factors responsible for the low level of productivity of common high-yielding wet land rice varieties raised during the winter seasons in Kerala. The Regional Agricultural Research Station, Pattambi is situated at 10°48′ north latitude and 76°12′ east longitude and at an altitude of 25 m from the mean sea level. Rice cultivation in the region is mainly confined to two major planting seasons, the autumn and winter, which coincides with the onset of south-west and north-east monsoon seasons respectively. The autumn (kharif) crop is raised from April-May to September-October and the winter (rabi) crop from September-October to December-January. The experiment was conducted in a split-plot design with seven planting dates centred around the main planting season of winter crop in Kerala (Aug. 22, Sep. 5, Sep. 18, Oct. 3, Oct. 16, Oct. 30, Nov. 12) as the main plot treatment and four popular high-yielding rice varieties (Bharathi, Jaya, IR-8 and IR-20) as the sub plot treatments in three replications. Twentyeight day-old seedlings were transplanted in the experiment with the normal package of practices[2]. Nitrogen, P_2O_5 and K_2O were applied @ 90:45:45 kg/ha respectively; 50% N, 100% P and 50% K were applied as basal, 25% N was applied as top dressing 20 days after planting and the remaining 25% N and 50% K were applied as top dressing at the panicle initiation stage. The sources of N, P and K were urea, single super phosphate and muriate of potash respectively. In addition to this, farm yard manure @ 5 tons/ha was applied as basal and incorporated into the soil one week before each transplanting. In all treatments water level was gradually raised and maintained at 5 ± 1 cm with the normal irrigation and drainage practices. Water was partially drained from the plots just before top dressing and was allowed to enter after two days. The water was also drained from the field 10 days before the harvest. Pests and diseases were completely checked by normal plant protection measures[2]. The gross plot size was 5 m × 4 m with a net plot size of 3.8 m × 3.4 m. The spacing was 20 cm × 10 cm. The soil of the experimental area was medium in available N, P and K. The pH of the soil was 6.1. The experiment was conducted during three winter seasons.

OBSERVATIONS

Observations on the total number of tillers, height of plants, phytomass accumulation, nutrient content and nutrient uptake were made at three stages, i.e., one month after planting, 50% heading stage and at harvest. The time of first heading, 50% heading and maturity were noted for each plot. The number of panicles per hill, the number of filled grains per panicle and the number of unfilled grains per panicle were recorded based on sampling techniques[3]. The yields of grain and straw were recorded from the net plots. The grain yield was expressed at 14% moisture content and the straw yield was recorded after sun drying to constant weight. All yields were expressed on hectare basis. From the day of initial sowing in the nursery to harvest, daily observations on weather parameters such as rainfall, maximum temperature, minimum temperature, mean daily temperature, solar radiation, relative humidity and wind velocity were recorded from the field meteorological observatory situated close to the field. The wind velocity was recorded at 2.75 m height with a cumulative self-recording anemometer and the solar radiation with a cumulative self-recording rimco electronic pyrranometer. The weather data pertaining to each date of planting for each crop were traced separately. The total crop duration was divided into four stages based on its physiological development. They are: (i) Seedling to panicle initiation stage (vegetative phase), (ii) Panicle initiation to 5 days before 50% heading stage (reproductive phase), (iii) 10 days centering 50% heading stage (flowering phase), and (iv) 5 days after 50% heading to 5 days before full maturity (maturity phase). The means of daily weather data for all the four stages were worked out for finding out their correlations on the yield. The results are presented and discussed below.

RESULTS AND DISCUSSION

All the relevant observations are presented in tables 1 to 8 and figures 1 to 3. In 21 different dates of plantings distributed over three years of the trial, there was yield variations from 0.3 to 4.7 t/ha for Bharathi, from 1 to 4.6 t/ha for Jaya, from 0.7 to 4.4 t/ha for IR-8 and from 1.2 to 5.2 t/ha for IR-20. The maximum depression in yield was recorded during the first year of the trial. It can be seen from the results that this wide variation in yield was primarily due to spikelet sterility and not because of any lack in the tillering, general growth or spikelet production of the crop (table 7, figure 3). Phytomass production at 50% heading stage showed that the growth of the crop was satisfactory during all planting dates (table 1). The straw yields also indicate this (table 3). The content and uptake of nutrients by the crop was also uniform and satisfactory and this also could not be attributed as a reason for the high spikelet sterility (table 1). Even though the flowering duration of all the varieties during all the years of study slightly decreased from first planting to last planting, it could not also be correlated with the spikelet sterility. There were no pests or disease attack. Hence it was suspected that the reason for spikelet sterility might be some climatological parameters that existed after the flowering. Therefore simple correlations were worked out between yield and weather components experienced during the four growth stages described earlier. The weather components during the vegetative and reproductive phases had no correlation with the yield or the spikelet sterility. But certain weather components

Table 1 *Phytomass accumulation and nutrient content of plants at 50% heading stage on oven dry basis as affected by dates of planting and varieties of rice at Pattambi*

Treatments	Phytomass accumulation at 50% heading stage (g/plant)		Nutrient content of plants at 50% heading stage (%) N content		P content		K content	
	1983-84	1984-85	1983-84	1984-85	1983-84	1984-85	1983-84	1984-85
Planting dates								
Aug. 22	14.0	11.5	1.2	1.6	0.23	0.22	2.3	1.5
Sep. 5	13.9	11.1	1.3	1.5	0.24	0.23	2.2	1.3
Sep. 18	14.0	12.7	1.4	1.4	0.23	0.23	2.3	1.6
Oct. 3	14.0	11.0	1.4	1.5	0.23	0.23	2.2	1.5
Oct. 16	14.5	12.2	1.4	1.6	0.23	0.22	2.2	1.4
Oct. 30	11.8	13.4	1.3	1.5	0.21	0.21	2.2	1.4
Nov. 12	11.6	11.8	1.3	1.4	0.21	0.21	2.3	1.4
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Varieties								
Bharathi	14.0	12.3	1.4	1.5	0.21	0.21	2.3	1.5
Jaya	12.7	12.0	1.2	1.4	0.23	0.23	2.1	1.5
IR-8	13.3	11.6	1.3	1.5	0.23	0.23	2.3	1.4
IR-20	13.6	11.9	1.4	1.5	0.22	0.22	2.2	1.4
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS

NS = Not significant.

Table 2 *Grain yield (t/ha) as affected by dates of planting and varieties of rice at Pattambi*

Varieties	Planting dates Aug. 22	Sep. 5	Sep. 18	Oct 3	Oct. 16	Oct. 30	Nov. 12	Mean
1983–84								
Bharathi	3.7	3.9	2.0	1.5	0.3	2.6	3.2	2.5
Jaya	4.6	3.2	2.2	1.0	1.6	3.1	1.8	2.5
IR-8	4.4	2.4	2.4	0.7	2.1	3.2	1.6	2.4
IR-20	4.0	2.4	2.9	1.2	1.6	2.9	2.2	2.5
Mean	4.2	3.0	2.4	1.1	1.4	3.0	2.2	—
CD (0.05)	Dates:	0.55;	Var:	NS;	Inter:	A-0.91;	B-0.96.	
1984–85								
Bharathi	4.1	3.2	3.2	3.4	2.7	3.3	4.0	3.4
Jaya	4.3	3.4	3.4	3.4	2.9	3.4	3.9	3.5
IR-8	3.6	3.1	3.6	2.8	3.2	3.1	3.6	3.3
IR-20	4.1	2.9	3.2	3.2	3.8	4.1	4.1	3.6
Mean	4.0	3.2	3.4	3.2	3.2	3.5	3.9	—
CD (0.05)	Dates:	0.54;	Var:	0.23;	Inter:	A-0.61;	B-0.75.	
1985–86								
Bharathi	2.6	4.2	4.1	4.7	3.5	4.0	4.6	3.9
Jaya	2.3	4.0	3.6	4.1	3.3	4.0	3.8	3.6
IR-8	2.2	3.9	3.6	3.6	3.4	4.0	3.7	3.5
IR-20	3.4	4.1	4.2	4.4	4.3	4.7	5.2	4.3
Mean	2.6	4.0	3.9	4.2	3.6	4.2	4.3	—
CD (0.05)	Dates:	0.80;	Var:	0.27;	Inter:	NS.		

NS = Not significant.

during the flowering and maturity phases exhibited significant correlation with the yield and the spikelet sterility. This led to the identification of certain weather factors that cause the yield decline in high-yielding photo-insensitive varieties grown during the winter season in Kerala. They are: (i) Excessive wind velocity during flowering and maturity phases; (ii) Low solar radiation during the maturity phase, and (iii) Occurrence of rainy days during the maturity phase. Any one or combinations of these

Table 3 *Straw yield (t/ha) as affected by dates of planting and varieties of rice at Pattambi*

Varieties	Planting dates Aug. 22	Sep. 5	Sep. 18	Oct. 3	Oct. 16	Oct. 30	Nov. 12	Mean
1983–84								
Bharathi	5.1	4.3	7.8	5.2	5.8	3.8	4.1	5.2
Jaya	3.3	4.1	4.7	4.1	3.9	4.8	4.0	4.1
IR-8	3.6	3.8	4.2	4.3	3.6	4.9	4.0	4.1
IR-20	4.3	4.5	5.3	4.6	4.8	5.2	4.4	4.7
Mean	4.1	4.2	5.5	4.6	4.5	4.7	4.1	—
CD (0.05)	Dates:	NS;	Var:	NS;	Inter:	NS.		
1984–85								
Bharathi	5.1	4.3	5.3	3.4	4.1	5.1	4.8	4.6
Jaya	4.0	4.0	4.7	4.4	4.1	4.9	5.0	4.4
IR-8	3.1	3.7	4.3	4.6	4.0	4.7	4.9	4.2
IR-20	4.9	5.2	4.2	5.9	5.3	4.8	5.4	5.1
Mean	4.3	4.3	4.6	4.6	4.4	4.9	5.0	—
CD (0.05)	Dates:	NS;	Var:	NS;	Inter:	NS.		
1985–86								
Bharathi	5.2	3.4	6.7	4.1	3.5	4.6	5.1	4.7
Jaya	4.8	5.2	3.8	3.9	4.7	4.3	4.6	4.5
IR-8	4.2	4.9	3.8	3.6	3.9	4.3	4.2	4.1
IR-20	5.4	6.8	4.5	5.0	4.0	4.2	5.1	5.0
Mean	4.9	5.1	4.7	4.2	4.0	4.4	4.8	—
CD (0.05)	Dates:	NS;	Var:	NS;	Inter:	NS.		

NS = Not significant.

Table 4 *Days to 50% heading as influenced by planting dates and varieties of rice at Pattambi*

Varieties	Planting dates Aug. 22	Sep. 5	Sep. 18	Oct. 3	Oct. 16	Oct. 30	Nov. 12	Mean
1983–84								
Bharathi	82	80	86	89	81	83	85	84
Jaya	90	94	91	96	87	86	89	90
IR-8	90	94	91	96	88	86	91	91
IR-20	90	94	91	95	87	87	89	90
Mean	88	91	90	94	86	86	89	—
1984–85								
Bharathi	86	85	81	78	80	86	74	81
Jaya	91	87	83	82	85	87	75	84
IR-8	92	87	84	84	87	87	79	86
IR-20	95	89	89	87	90	88	84	89
Mean	91	87	84	83	86	87	78	—
1985 86								
Bharathi	83	79	78	76	75	79	80	79
Jaya	86	88	85	83	82	86	86	85
IR-8	87	90	85	82	82	81	85	85
IR-20	90	91	86	87	88	88	86	88
Mean	87	87	84	82	82	84	84	-

factors existed in a particular case for inducing spikelet sterility and consequent abrupt declines in yield in certain of the cases. The simple correlation coefficient (*r*) and multiple correlation coefficient (*R*) of the above climatic parameters with the yield and the sterility are given in table 6. In order to predict the yield of four varieties under the above climatic constraints, preliminary linear regression models are

Table 5 *Weight of thousand grains (g) as affected by dates of planting and varieties of rice at Pattambi*

Varieties	Planting dates							Mean
	Aug. 22	Sep. 5	Sep. 18	Oct. 3	Oct. 16	Oct. 30	Nov. 12	
1983–84								
Bharathi	29.1	28.5	28.6	26.3	22.5	27.6	26.7	27.0
Jaya	30.7	29.7	28.7	27.9	28.8	28.5	30.3	29.2
IR-8	29.5	30.0	29.5	27.9	28.1	28.3	28.1	28.8
IR-20	20.1	20.2	21.4	19.3	19.4	20.2	18.6	19.9
Mean	27.4	27.1	27.1	25.4	24.7	26.2	25.9	—
1984–85								
Bharathi	28.6	27.9	28.0	27.9	26.7	27.5	27.5	27.7
Jaya	29.8	29.2	29.1	29.1	27.9	28.6	28.4	28.9
IR-8	28.9	28.6	29.2	28.3	26.2	28.0	26.6	28.0
IR-20	21.0	20.0	20.7	20.2	20.5	19.9	19.9	20.3
Mean	27.1	26.4	26.8	26.4	25.3	26.0	25.6	—
1985–86								
Bharathi	28.9	27.8	28.2	27.7	26.4	27.5	27.6	27.7
Jaya	29.9	29.4	29.7	29.2	27.7	28.7	28.5	29.0
IR-8	29.2	28.8	29.8	28.0	26.1	28.1	26.8	28.1
IR-20	21.5	20.1	20.9	20.3	20.3	19.9	19.8	20.4
Mean	27.4	26.5	27.2	26.3	25.1	26.1	25.7	—

Table 6 *Simple correlation coefficient (r) and multiple correlation coefficient (R) of important weather parameters with yield and percentage spikelet sterility of rice at Pattambi**

Independent variable	Bharathi		Jaya		IR-8		IR-20	
	Yield	Sterility	Yield	Sterility	Yield	Sterility	Yield	Sterility
X_1	−0.72	0.75	−0.58	0.63	−0.56	0.44	−0.52	0.57
X_2	−0.79	0.79	−0.55	0.62	−0.34	0.38	−0.44	0.45
X_3	0.39	−0.36	0.56	−0.44	0.38	−0.33	0.57	−0.53
X_4	−0.50	0.39	−0.70	0.61	−0.57	0.37	−0.64	0.57
R	0.88	0.85	0.91	0.88	0.72	0.62	0.77	0.77
R^2	0.75	0.72	0.82	0.77	0.52	0.38	0.60	0.60

X_1 = Mean wind velocity at flowering phase; X_2 = Mean wind velocity at maturity phase; X_3 = Mean solar radiation at maturity phase; X_4 = Number of rainy days at maturity phase; R = Multiple correlation coefficient; R^2 = Coefficient of determination; *$n = 21$.

Table 7 *Observations on crop and weather parameters as affected by different dates of planting (average of three years)*

Observations	Planting dates						
	Aug. 22	Sep. 5	Sep. 18	Oct. 3	Oct. 16	Oct. 30	Nov. 12
Weather parameters							
Mean solar radiation (mwh/cm²/day)	473	477	485	488	483	489	502
Cumulative solar radiation (mwh/cm²/crop period)	54669	56893	57382	57560	57222	56671	56881
Mean max. temp. (°C)	29.9	30.1	30.3	30.6	30.7	30.9	31.5
Mean min. temp. (°C)	23.0	22.7	22.5	22.1	21.9	21.7	21.7
Mean wind velocity (km/h)	2.9	3.2	3.6	4.1	4.1	4.2	4.2
No. of rainy days	53	42	33	29	25	16	11
Crop parameters							
Grain yield (g/m²)	360	339	321	284	274	354	347
Panicles/m²	339	348	347	363	353	381	393
Filled grains/panicle	44	40	36	30	33	39	36
Spikelet sterility (%)	44	50	56	61	61	51	53
Grain yield (kg/ha)	3604	3389	3205	2835	2736	3540	3472

Table 8 *Ranges in stage-wise means of important weather components common to all varieties during the experimental period at Pattambi*

Growth phases	Mean max. temp. (°C)	Mean min. temp. (°C)	Mean RH (%)	Mean wind velocity (km/h)	Mean solar radiation (mwh/cm²/day)	No. of rainy days
Vegetative phase (57 days)	28.9–31.3	21.8–23.5	76–89	1.85–5.12	402–531	3–2
Reproductive phase (25 days)	29.5–31.5	17.8–23.3	67–75	1.31–6.82	429–547	1–8
Flowering phase (10 days)	29.4–32.0	16.9–23.3	64–83	1.09–8.62	394–583	0–5
Maturity phase (20 days)	30.2–32.4	18.2–23.0	62–77	1.40–8.51	430–538	0–5

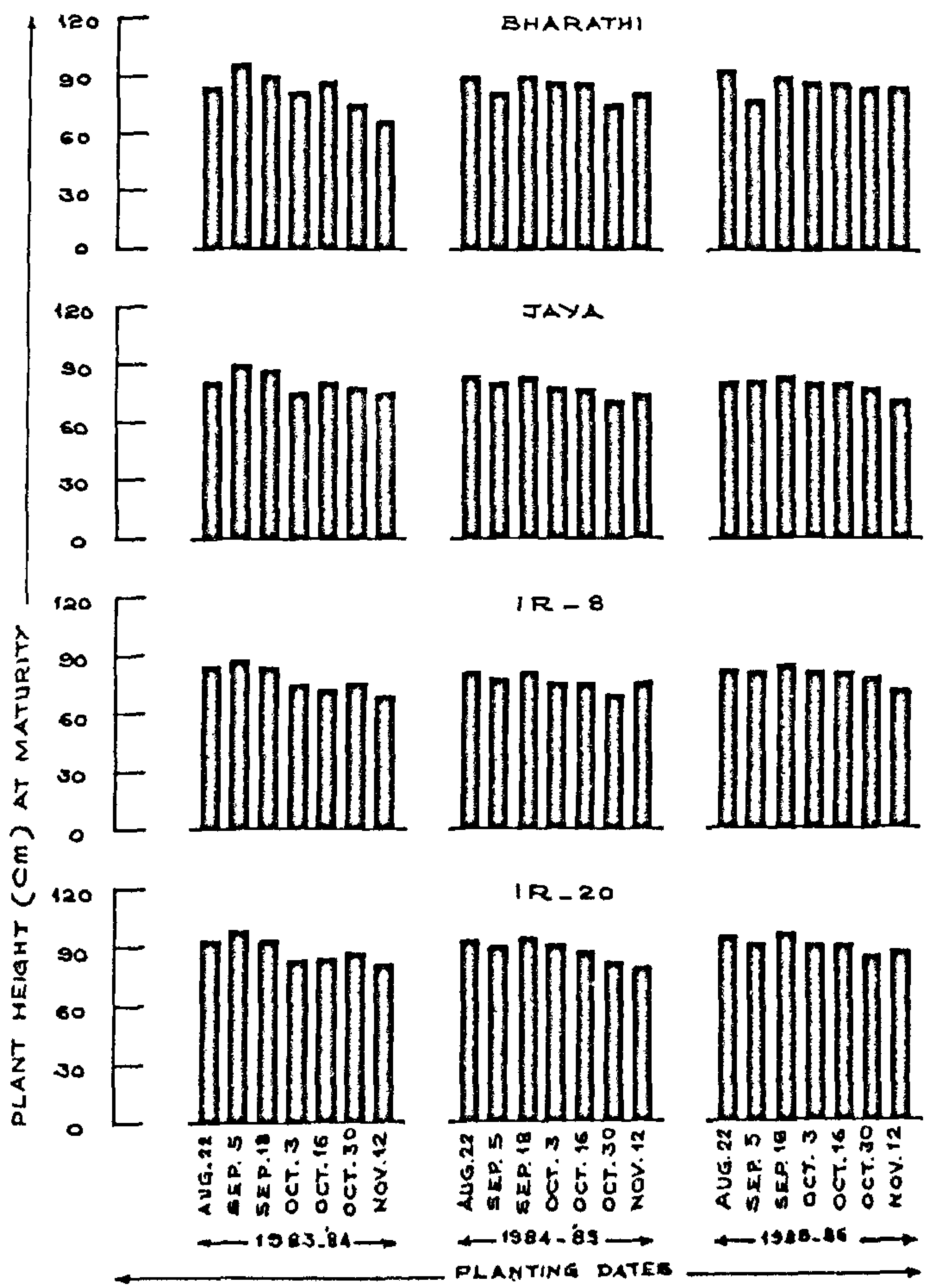

Figure 1. Plant height and maturity as affected by dates of planting and varieties of rice at Pattambi.

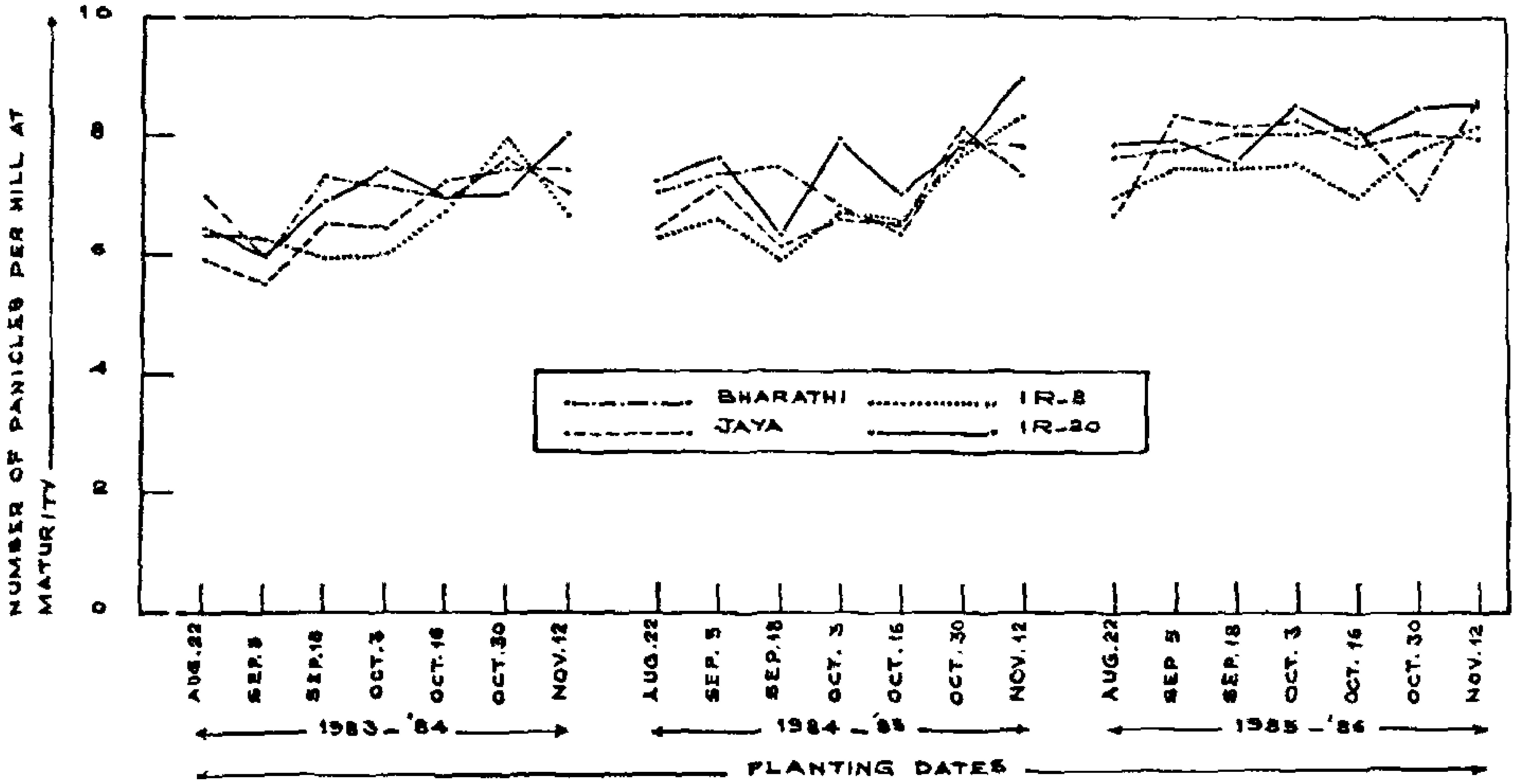

Figure 2. Number of panicles per hill as affected by planting dates and varieties of rice at Pattambi.

derived and presented below.

Bharathi: $Y=5220-154x_1-624x_2+0.569x_3-162x_4$ $(R^2=0.75^*)$,

Jaya: $Y=1825+14x_1-475x_2+6.759x_3-295x_4$ $(R^2=0.82^*)$,

IR-8: $Y=1071-219x_1-226x_2+7.098x_3-143x_4$ $(R^2=0.52^*)$,

IR-20: $Y=-1464-162x_1-320x_2+13.002x_3-92x_4$ $(R^2=0.60^*)$,

*Significant at 1% level,

where,

Y= predicted yield in kg/ha; x_1 = mean wind velocity during the flowering phase in km/h; x_2 = mean wind velocity during the maturity phase in km/h; x_3 = mean solar radiation during the maturity phase in mwhr/cm^2/day; x_4 = number of rainy days during the maturity phase.

The ranges in stagewise means of important weather components common to all varieties during the experimental period at Pattambi are given in table 8. Although the phenomenon of yield decline was more predominent for the crop raised during the three middle planting dates (Sep. 18, Oct. 3 and Oct. 16), the results revealed that the yield reduction can occur under the influence of the above adverse weather irrespective of the planting dates adopted. The effects of these weather components identified above on the yields of the rice are briefly discussed below:

Effect of wind

Small breezes are beneficial for the rice crop during all stages because it reduce the boundary layer resistance and increases the photosynthetic efficiency[4]. But excessive wind velocity damages the rice crop especially during flowering and maturity stages[5-21]. Excessive wind velocity during flowering causes pollen dehydration and consequent spikelet sterility[5]. Similarly high wind velocity at maturity stages hampers the development of spikelets and consequently causes excessive spikelet sterility[5]. Under high wind velocities, the water balance of the rice crop is adversily affected by creating water deficit due to greater evapotranspiration than the water absorption by the rice plant. At this stage the stomata automatically closes and the carbon dioxide intake ceases thus hampering the photosynthetic activity[6,22]. This results in poor yield due to high sterility of spikelets. The negative correlation and regression obtained for the wind velocity with the yield of four rice varieties in the present experiment can be explained as discussed above. During the first year of the trial, when the maximum decline in yield

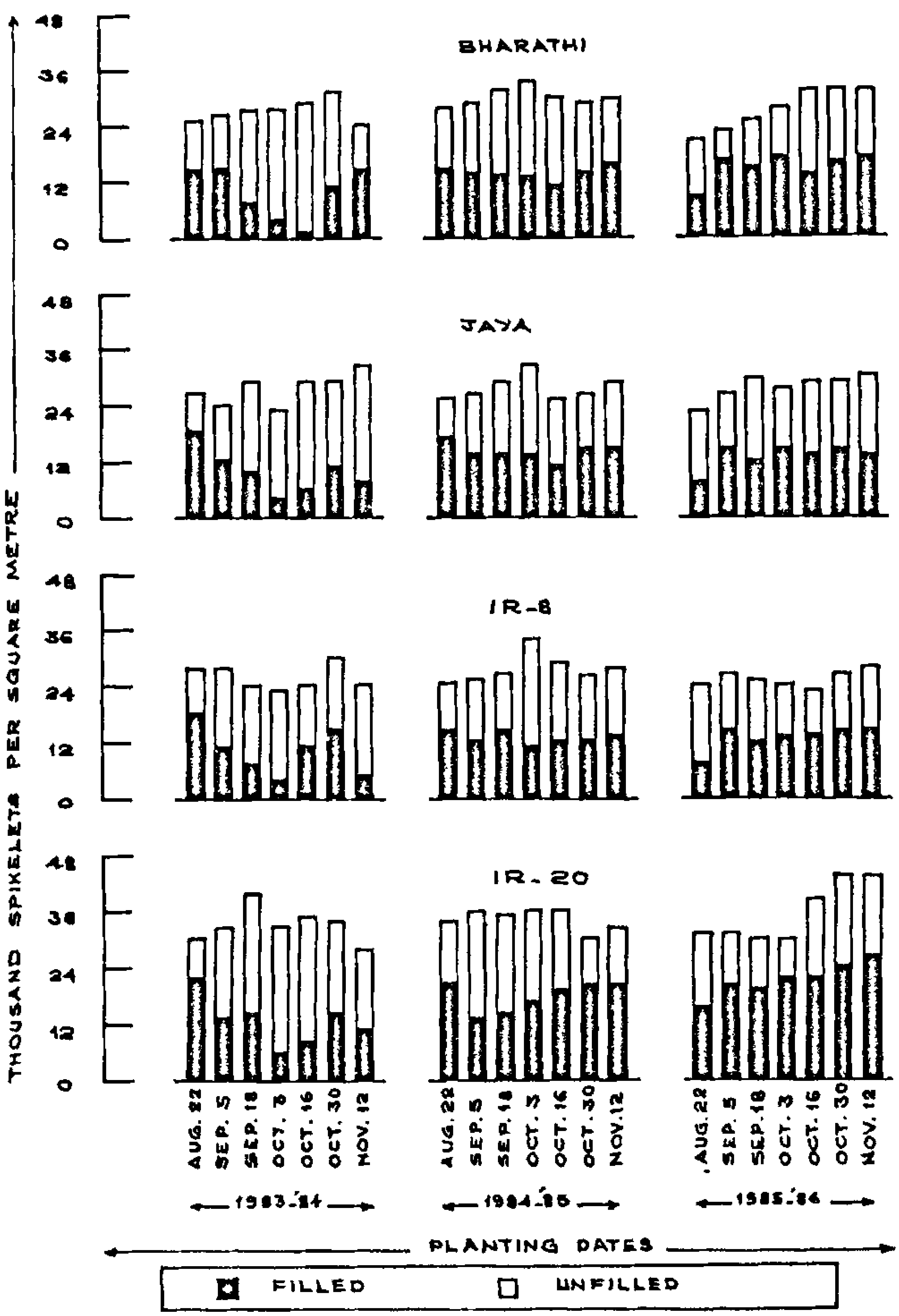

Figure 3. Number of spikelets (separated as filled and unfilled) as affected by planting dates and varieties of rice at Pattambi.

was noted for some treatments, the corresponding daily mean wind velocity at flowering and maturity stages ranged from 7.8 to 10.3 km/h. This is the recorded average of 24 h, but the nights are usually calm during these periods and hence if the day time velocity is alone assumed, it may range from 12 to 15 km/h which is sufficiently high. Adverse wind effects in rice plant can be overcome with suitable varieties as some upland varieties were found definitely superior in resisting wind damage[7]. In Tamil Nadu some varieties have been identified as resistent to wind damages in earlier stages[8]. Plants grown in low levels of nitrogen were found to have high resistance to wind damages expressed in terms of percentage of ripened grains and weight and thickness of grain[9,12]. Even in rice plants grown in submerged soils transpiration on hot, sunny, windy days far exceeds the water absorption and consequently severe midday water deficits may develop. Plant water deficit may be caused by excessive transpiration or by slow absorptions or by the combination of the two[10,17]. Water deficits are more severe in upper leaves which feeds the developing panicles to the maximum extent. The reason for high sterility under excessive wind velocity is thus well-established.

Effect of solar radiation

In the present study a positive relation was established for solar radiation during the maturity phase. Solar radiation is the only source of energy available for photosynthesis and hence its deficiency will seriously affect the yield of plants particularly after flowering. Shading during the ripening period considerably reduces the grain yield largely because it reduces the percentage of filled grains. Solar radiation during the grain filling period determines the solar energy available for grain filling[23,24]. Grain yield is positively correlated with solar radiation during the later stages of plant growth[25–28]. The effect of solar radiation from flowering to harvest time is in filling up spikelets and will be reflected in the number of filled spikelets and weight per spikelet[29,30]. Varietal differences were also noted in the degree of sterility as a result of solar radiation[29]. The positive relationship of rice yield with solar radiation during the maturity phase is thus substantiated.

Effect of rain-fall during maturity

A negative relationship was established between yield and number of rainy days during the maturity stage. Rainy days are detrimental to rice crop particularly from flowering to maturity phase[4]. Rainy conditions may cause fungal attack in the developing spikelets, thus making them sterile. High percentage of sterility occurs under rainy weather conditions[31,32]. The negative effect of rainy days at maturity stage is thus substantiated.

FUTURE LINE OF WORK

Reactions against high wind and low solar radiation can be overcome by evolving resistant varieties as some varieties were found to be resistant to these factors. It can also be overcome by management practices such as low nitrogen dose, application of silicate fertilizers, etc. since high nitrogen and low silicate availability were found to increase the damages due to high wind and low solar radiation. Identification of suitable wind breaks in rice fields for resisting wind damages are also necessary.

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ANNOUNCEMENT

SEMINAR ON MARBLE, GRANITE AND OTHER DECORATIVE STONES OF RAJASTHAN

The above seminar will be held during middle of April 1989 at the Department of Mines and Geology, Shastri Circle, Udaipur 313 001. It is proposed to hold the following sessions to discuss geology, genesis, economics and mining of the marble, granite, limestone, sandstone, shale, serpentine, dolerite, gabbro, slate etc. The four Sessions are: 1. Geology of the Resources, 2. Exploration and Mining Techniques, 3. Processing and Marketing, 4. Economics and Legislations.

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