Studies on the Optimum Time of Harvesting of Rice

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In a study on optimum time of harvesting of rice (Var. Jagannath), It was found that, the moisture content in grains decreased at the rate of 0.583% per day, reaching 15.93% at harvesting. The crop harvested at 22% grain moisture content gave the maximum yield. The grains attained physiological maturity at 36 days after heading. Thirty three to 39 days after heading is the optimum time of harvesting of rice (Var. Jagannath).

Time of harvest primarily determines the quality of dehusked rice grain. It is estimated that in India about 9.3% of the total rice grains is lost in various harvest and post-harvest operations, (Anon.. 1971). The harvesting losses take place because the crop in conventionally harvested at 16 to 17% moisture content of the grain. The farmers adjudge maturity by observing the golden colour of grains. At this time, the g ains contains 22 to 24% moisture. In order to reduce losses during harvest, early harvest is beneficial. This saves valuable time for field preparation and sowing the next crop, thus increasing the effective utilization of land and labour.

A study was taken up to investigate the effect of the time of harvest on yield and milling quality of rice at the Agricultural Engineering Department, Indian Institute of Technology, Kharagpur (West Bengal), with rice (Var. Jagannath) from July to December 1977.

MATERIAL AND METHODS

The field experiment was carried out in a sandy clay loam soil with pH 5 4, organic carbon 0.38%, available Nitrogen 0.041%. available P 0.004% and available K 0.030%. The experiment was laid out in a Randomised Block design with eleven treatments of harvesting times starting from 18 to 48 days after heading with three replications. There was an interval of three days between two harvesting treatments. Observations of grain moisture content were recorded from five randomly selected plants in each plots. Grains obtained from each plot were collected, weighed for their moisture content and sun dried to 14% moisture content. The dried samples were milled in a standard rice mill and the head rice recovery was determined. The field yield was taken to mean the unhusked grain yield, adjusted to 14% moisture A single variable quadratic production function was fitted to the data in the following form.

$$Y = a + bx - cx^2$$

where Y = Field yield,

X = Number of days after heading,

a, b and c are parametric coefficients.

A linear relationship between harvest grain moisture content and harvesting times was obtained.

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$$M = a - bx^2$$

where M = moisture content (%).

 X = Number of days after heading a and b are parametric coefficients.

 To determine the optimum time of harvesting, the critical difference (CD) of the treatment yield means distributed equally to both the sides of peak yield points in a parabolic curve was taken and the Maximum average field yield per period were calculated as under.

$$\text{Average yield/period} = \frac{1}{n} \left(\sum_{i=1}^{i=n.} FY_i \right)$$

where FY = Field, q/ha,

 n = Number of days in harvesting period and

 i = ith day after heading.

RESULTS AND DISCUSSION

 Data on field yield of grain harvested between 18 to 48 days after heading showed a parabolic variation with respect to days after heading (Table I). The field yield increased at every hervesting in the beginning, reaching the maximum at 33 (observed) and 36 (Predicted) days after heading and thereafter it declined upto last harvest at 48 days after heading, (Table II). Increase in field yield from 18 to 33 days after heading is due to grain development and maturity in this period. Lower yields obtained in the early harvesting were due to increase in the number of immature and shrivelled grains.

 Apparently, rice grain attains physiological maturity at 36 days after heading as evidenced by the maximum field yield (predicted) of 28.48 q/ha obtained when the crop was harvested at this time· Harvesting after physiological maturity (after 36th day of heading) resulted in yield losses because of shattering of grains. This loss increased with the decrease in moisture content of grain.

 Head yield of rice harvested at different times showed a parabolic variation with maximum value (74.77%) falling on 33th day after heading (Table I) Immature grains harvested early gave large quantity of broken grains on milling. The poor head yield might have been due to chalky and white belly rice, which are more fragile than healthy sound grains. These results are supported by the findings of Mahadevappa et al. (1979). Rangnath et al. (1970) reported that rice harvested after 33rd day of heading developed cracks in the kernals due to non-uniform drying and this resulted in poor head yield.

 Grain moisture content declined at the rate of 0.583% per day between 33.36 to 15.93% during the harvesting period of 30 days (Table I). The decrease in the moisture content of grain upto 36th day of heading was due to sun-drying. Grain harvested at about 22% moisture content gave maximum field yield, total and head yield. These results are supported by the findings of Nawab Ali et al. (1975).

 The optimum time of harvesting is 36th day after heading. It may not be practically possible to harvest the crop in a single day if the area is large. Therefore, the optimum period was deter-

mined by using the value of critical difference. (C D) of treatment mean. The period of 33 to 39 days after heading has been obtained as optimum time of harvest because of smaller losses in yield in this period.

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TABLE I   Effect of time of pharvesting on field yield head rice recovers and moisture content.

Treatment no. (1)	No. of days after heading (2)	Moisture content of harvest (3)	Field yield (at 14% moisture) (q/ha) (observed) (4)	Head rice recovery (%) (5)
T₁	18	33.36	20·42	59.88
T₂	21	31.60	23.27	72.11
T₃	24	28.96	24.69	70.99
T₄	27	26.50	26.71	72.71
T₅	30	24.03	27.38	73.44
T₆	33	22.10	29.74	74.77
T₇	36	21.68	28.12	72.55
T₈	39	20.46	27.30	72.32
T₉	42	18.96	27.37	72.11
T₁₀	45	16.53	26.50	73.10
T₁₁	48	15.93	25,33	69.78
SE		0.547	1.35	0.410
C. D.ₘ (P=0.05)		1.614	3.99	1.209

TABLE II Calculation of field losses and growth losses at different times of harvest.

Treatment No.	No. of days after heading	Calculated moisture content of (%)	Field yield (Y) (q/ha.) Observed	Field yield (Y) (q/ha.) Calculated**	Growth losses (Y Max-Y) (q/ha)	Field loss (Y Max-Y) (q/ha.)	Loss of rice grain $\frac{(Y\,Max-Y)}{Y\,Max.} \times 100\%$	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
T_1	18	33.36	20.42	20.66	7.82		27.45	
T_2	21	31.60	23.27	23.06	5.42		19.03	
T_3	24	28.96	24.69	25.02	3.46		12.15	
T_4	27	26.50	26.71	26.54	2.94		6.81	
T_5	30	24.03	27.38	27.62	0.86		3.02	
T_6	33	22.10	29.74	28.27	0.21		0.73	Optimum harvest period
T_7	36	21.66	28.12	28.48	0.00		0.00	Calculated maximum yield 28.48 q/ha.
T_8	39	20.46	27.30	28.25		0.23	0.81	
T_9	42	18.96	27.37	27.58		0.90	3.16	
T_{10}	45	16.53	26.50	26.47		2.01	7.05	
T_{11}	48	15.93	25.33	24.93		3.65	12.46	

$*M = 42.88 - 0.583 \times X$

$** Y = -2.964 + 1.75 \times X = 0.0248 X^2.$

TABLE III Field yield of rice (Jagaunath) under conventional and modern methods of harvesting.

Completion of Harvesting Days	Conventional method Average field yield (q/ha)	Conventional method Moisture content at harvest (%)	Modern method Days after heading	Modern method Average field yield q/ha	Modern method Moisture content at harvest (%)	Loss due to conventional practice of Harvesting %
1	27.85	18.99-00.00	36-00	28.48	21.92-00.00	2.21
2	27.71	18.41-18.99	36-37	28.47	21.32-21.92	2.70
4	27.38	17.24-18.19	35-38	28.46	20.74-22.53	3.82
6	27-00	16.08-18.99	34-39	28.41	20.16-23.08	5.19
8	26.55	14.91-18.99	33-40	28.36	19.57-23.65	6.77
10	26.02	13.74-18.99	32-41	28.28	18.99-24.24	8.54
15	24.41	10.82-18.99	29-43	28.03	17.82-25.98	14.21

The maxium yield of crop obtained during the experiment was 28.48 q/ha.