Studies on Black Point on Endosperm of Rice Kernel*

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ABSTRACT

Some of the kernels of Jirasal variety of paddy has a distinct black point on endosperms at centre on dorsal side. The percentage of kernels with such point vary in different samples and their distribution in a panicle appears random. The point seems to be governed by gene or genes with variable penetrance and expressivity. Differient doses or splits of nitrogen fertilizer or spacing do not affect the expression of the character. The time of seeding has distinct effect on percentage of such kernels. With delayed seeding, percentage of kernels with black point increases. Though nonsignificant, delayed transplanting i.e., use of more aged seedlings also increases percentage of such kernels. Delayed seeding which affects the proportion of kernels with black point does not affect other grain characters i.e., length, breadth, or weight of grain or the spikelet sterility.

INTRODUCTION

JIRASAL is one of the traditional varieties of rice under cultivation in parts of Gujarat State. J-280 is an improved strain developed by selection. Both of them have more or less similar kernel characteristics. The varieties are classified as long slender as per rice classification suggested by Ramiah Committee and as fine based on quality index of paddy.

A certain proportion of kernels of these varieties has a small black point on endosperm. The point is located practically in the middle on the dorsal side i.e., side opposite to the embryo (Fig.1). The point is about 0.325 mm in diameter and under microscope it appears more or



Fig. 1. Photograph showing the kernels of Jirasal-280 with black point.

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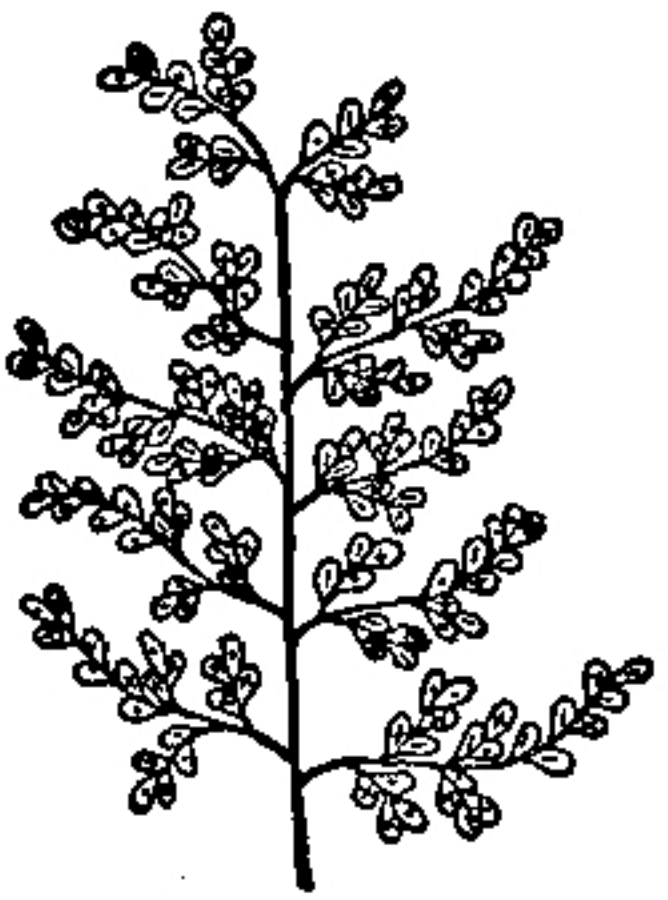
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less globular, slightly protruding structure. If the point is scrapped off, it leaves a small scar or cavity on the endosperm. This point persists on milled, polished rice. It is discernible even on cooked rice. It does not seem to be due to any physiological or pathological abnormal conditions. In trade Jirasal is valued as a quality rice and this black point is accepted as one of the criteria for identification of the variety. However, no information on the significance or the behaviour of this point is available. A study has, therefore, been undertaken to understand the nature of this point.

Black point has not been reported on any other rice variety. Further no literature is available on this point. As the point is visible only after the husk is removed and as normally rice can be germinated only with huskon i.e., as paddy, studies on this point are probably rare.

Fig. 2. Panicle of J-280, showing the distribution of kernels with black point.



METHODS

Husk from the paddy was removed by hand. A slight hand polishing of the dehusked grains was done by rubbing between thumb and fingers and the individual kernels were examined against light, with the help of 10 x magnifying lense. Kernels with and without the point were classified separately and percentages of kernels with balck point were calculated. Studies were undertaken on the following sources of seed:

(1) Indigenous variety being grown under various names of Jirasal.

(2) Commercial variety J-280.

(3) Seeds of individual plants selfed for last 15 or more generations from breeder's stock of J-280.

(4) Randomly selected individual panicles of the variety J-280.

(5) Panicles borne on different tillers of the same plant.

(6) Seeds from replicated trial on J-280, undertaken to study the effect of different doses and split application of nitrogen fertilizer.

(7) Seeds from replicated trial on J-280, undertaken to study the effects of different age of seedling and different doses of nitrogen fertilizer.

(8) Seeds from replicated trial on J-280 undertaken to study the effects of dates of seeding cum spacings between hills at transplanting.

In replicated trials the data were statistically analysed after angular transformation.

RESULTS

The results are presented below:

The details of kernels with and without black point in commercial produce as well as in individual plants selfed for a number of generations are given in Table 1.

TABLE—1

Percentage of kernels with black point in Jirasal rice.

Sr. No.	*Details*	*Kernels with black point per cent*
1.	Ahmedabad Jirasal	21
2.	Mehsana Jirasal	25
3.	Jira local	37
4.	Commercial Jirasal (local)	38
5.	Commercial Jirasal—280	31
6.	J—8—3 (Selection from Jirasal)	56
7.	Individual plants of J—280 selfed for more than 15 generations	33

The percentage of kernels with black point on each branch of a panicle was also studied. The results are given in Table 2.

TABLE—2

Branchwise distribution of kernels with black point on endosperm.

Branch number counted upwards	*per cent Kernels with black point*		
	No. of panicles studied		
	I	*II*	*III*
1.	33.3	44.4	71.4
2.	35.0	42.7	20.0
3.	41.6	75.0	69.2
4.	36.3	8.3	33.3
5.	40.0	25.0	20.0
6.	47.0	28.5	34.4
7.	52.3	30.0	67.8
8.	20.0	38.8	22.2
9.	40.0	31.2	—
10.	33.0	00.0	—
11.	66.6	66.6	—
12.	25.0	33.3	—
13.	—	60.0	—
Mean	40.8	35.6	37.7

The actual position of kernels with and without black point on an average panicle is shown in Fig. 2.

The proportion of such kernels on panicles borne on different tillers of the same plant was studied. The results are given in Table 3.

TABLE—3

Percentage of kernels with black point on different tillers of the same plant.

Plant No.	*Tiller No.*							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1.	31.9	31.7	20.7	25.9	26.2	29.61	33.3	26.1
2.	16.8	25.2	15.3	12.5	28.5	32.5	—	—
3.	19.6	24.2	18.5	27.1	12.8	20.1	—	—
4.	15.7	28.2	21.9	18.8	10.0	10.0	—	—

The data on the effects of different doses of nitrogen given in different splits on the percentage of kernels with black point are given in Table 4.

TABLE—4

Percentage of kernels with black point under different doses of nitrogen given in different splits (angular transformation).

	Kg.N/ha		
Split/Dose	*75*	*100*	*Average for splits*
50% before planting	32.6	35.9	34.3
+50% at tillering	(29.3)	(34.5)	(31.9)
50% before planting	37.2	37.6	37.4
+50% panicle initiation	(36.8)	(37.5)	(37.2)
75% before planting	36.4	36.8	36.6
+25% panicle initiation	(35.3)	(36.0)	(35.7)
Average for doses	35.4	36.8	36.1
	(33.8)	(36.0)	(34.9)

Actual figures in parenthesis.
SEm : 1.65
C.D.—Dose of nitrogen : N.S.
C.D.—Split of nitrogen: N.S.

The trial had an additional treatment of fertilizer as 100 kg N/ha splitted as 30 per cent basal + 25 per cent 15 days after transplanting + 10 per cent 32 days before heading (i.e. at panicle initiation) + 10 per cent 18 days before heading (i.e. reduction division stage) + 25 per cent at heading. In this treatment also the average percentage kernels with black point was 31.3.

The data on the effects of different age of seedling at the time of transplanting and different doses of nitrogen given to the field on the percentage of kernels with black point are given in Table 5.

The data on the effects of different dates of seeding and different spacings at which transplanted, on the percentage kernels with black point are given in Table 6.

In this experiment, where the differences in the number of kernels with black point were significant for dates of seeding, effects of different dates of seeding on yield of paddy per plot, plant height, days to panicle initiation, flowering and maturity, number of panicles per plant, panicle length, number of spikelets per panicle and the spikelet sterility as well as length, breadth and weight of grains were studied. The details are given in Table 7.

DISCUSSION

Rice is a *highly self* pollinated plant. The variety under reference is under cultivation since last few hundred years and thus it has undergone many generations of selfing. Studies with regard to the percentage of kernels with black point on plants artificially selfed for more than 15 generations also give more or less similar results as the commercial variety. If the character was controlled by normal genes, all kernels of a well selfed particular plant under study should be with or without black point. Normally a single plant is not expected to bear kernels of both the types. The study under reference, however, indicates otherwise. The proportion of such kernels to total varies (Table 1).

The studies on distribution of branches in a panicle (Table 2) and spikelets (Fig.2) within a branch of a panicle as well as different panicles of the same plant (Table 3) carrying kernels with black point suggest their random distribution.

Thus the gene or genes governing this character may have variable penetrance. The size and brightness of the point also vary from kernel to kernel and thus the gene or genes concerned may also have variable expressivity. Such gene action is rather rare. Some such cases are the dominant gene causing deficiency of chlorophyll in unifoliate leaves of the lima bean variety Ventura, the genes for Huntington's Chorea and taste blindness for PTC (phenyl-thio-carbamide) in human beings.

TABLE—5

Effect of age of seedlings and different doses of nitrogen on the percentage kernels with black point (angular transformation).

Dose	*Age of seedling at T.P. in days*						
N Kg/ha	*25*	*35*	*45*	*55*	*65*	*75*	*Av. for dose of Nitrogen*
75	38.8	41.9	37.7	36.6	43.5	42.8	40.7
	(39.3)	(44.7)	(37.3)	(40.7)	(47.3)	(46.3)	(42.6)
100	40.2	41.6	38.6	41.6	43.5	47.1	42.1
	(41.7)	(44.0)	(39.0)	(44.0)	(47.2)	(51.0)	(44.5)
Av. for age	39.5	41.8	38.2	40.6	43.5	45.0	41.4
of seedling	(40.5)	(44.4)	(38.2)	(38.2)	(47.3)	(48.7)	(43.6)

Actual figures in perenthesis. SEm: 2·23

C.D.—Dose of nitrogen: N.S. C.D.—Age of seedling : N.S.

TABLE—6

Effects of different dates of seeding and transplanting seedling of the same age at different spacing on the percentage kernels with black point (angular transformation).

Spacing at T.P.	*Date of seeding and T.P.* *1-7-72 25-7-72*	*12-7-72 5-8-72*	*24-7-72 17-8-72*	*Average for spacing*
30cm x 20 cm	34.3	39.5	49.5	41.1
	(31.8)	(40.5)	(57.8)	(43.4)
30 cm×15 cm	32.9	38.6	52.7	41.4
	(29.5)	(39.0)	(63.3)	(47·3)
Av. for seeding	33.6	39.1	5.11	41.3
and T.P. dates	(30.7)	(39.8)	(61.1)	(45.4)

Actual figures in parenthesis.

	SEm	C.D.
Spacing	1.37	N.S.
Date of seeding	1.04	3.19

TABLE—7

Effects of different dates of seeding on various characters of Jirasal-280 variety of paddy.

Character		*Sowing and Transplanting Date*			SEm	C.D.
		1-7-72 25-7-72	*12-7-72 5-8-72*	*24-7-72 25-8-72*		
Kernel with black point	*Percentage**	33.6 (30.7)	39.1 (39.8)	51.1. (61.1)	1.04	3.19
Yield of paddy	Kg/plot	20.0	19.0	16.5	0.38	1.20
Plant height	Cms	131	127	116	1.26	3.87
Panicle initiation	No. of days from sowing	82	75	71	0.15	0.46
	Actual date	20-9-72	25-9-72	3-10-72	N.A.	
Flowering	No. of days from sowing	109	106	99	0.27	0.83
	Actual date	17-10-72	25-10-72	30-10-72	N.A.	
Maturity	No. of days from sowing	132	122	115	011	0.34
	Actual date	10-11-72	12-11-72	18-11-72	N.A.	
Panicles	No. per plant	9.9	11.0	13.4	0.42	1.29
	Length in cm	27	25	24	0.43	1.32
Spikelet	No. per panicle	264	225	160	7.5	22.8
	Sterility*	30.3	28.2	30.7	1.46	N.S.
	Percentage	(25.6)	(22.5)	(25.9)		
Grains	1000 gr. wt. gm	16.2	16.2	16.0	0.13	N.S.
	Length mm	8.6	8.6	8.6	0.08	N.S.
	Breadth mm	2.3	2.3	2.3	0.02	N.S.

*Angular tranformation for measurements in percentage.
Actual figures in parenthesis. N.A.=Not analysed.
N.S.=Not significant.

The results of various agronomic treatments indicate that various doses of nitrogen (Table 4, 5) or different splits of its application (Table 6) do not materially affect the percentage of of such kernels. Even application of nitrogen at the time of reduction division as well as heading, which is particularly available when the kernels are developing dose not seem to have any effect on the expression of the character. Similarly there is no effect of different spacing on the character either (Table 6). However, there is a marked effect of time of seeding on the percentage of kernels with black point (Table 6). As the seeding is delayed, there is definite increase in the proportion of such kernels. In case of the trial with different age of seedling at the time of transplanting,

with a constant seeding date, though the differences in the percentage of kernels with black point have just missed to reach the 5 per cent level of significance, there is some indication that delayed transplanting with more aged seedlings also increases the percentage of kernels with black point (Table 5).

The data from the studies of various characters, as affected by different dates of seeding, which significantly affects the proportion of kernels with black point (Table 8), indicate that none of the important grain characters i.e., grain length, breadth and weight as well as spikelet sterility with which the black point should be expected to have some relations, have been affected. Though the late seeding has resulted in shortening of duration from seeding to panicle initiation, flowering as well as maturity, actually they are late in the season as far as their actual dates are concerned. These late seeded plants have borne significantly less number of spikelets per panicle. Thus the incidence of black point on spikelets is higher in poorly developed panicles.

The total number of spikels per plant decreases as the sowing is delayed, which ultimately reduces the yield. It is expected that the proportion of late produced tillers would be more on the late sown plants than on the early sown plants. Hence proportion of late produced kernel would also be more in the late sown plants than in the early sown plants. Further the proportion of kernels with black point is also more in the late sown plants than in the earlier sown plants. It seems, therefore, that there is some co-relation between the late produced spikelets and expression of black point on the kernel. This is supported by the data given in Table 5. Indications, therefore, are that the expression of black point may be dependant on the environment and that some stages between late tillering stage to grain development stage are more responsive to the environmental effects in the expression of this character. This needs to be confirmed through further tests.

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