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https://doi.org/10.5109/23933

出版情報：九州大学大学院農学研究院紀要. 33 (3/4), pp.229-234, 1989-03. Kyushu University
バージョン：
権利関係：

J. Fac. Agr., Kyushu Univ., 33 (3•4), 229-234 (1989)

Wheat Cultivation in Tangail District of Bangladesh

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(Received September 30, 1988)

A survey on 20 farmers' wheat fields was conducted at 8 villages in Tangail District, Bangladesh in 1987-88 dry season. All of the surveyed fields were under rain-fed conditions. Information on cultural practices was collected using predesigned questionnaires. Observations on plant density and nutritions, and grain yield and yield components were also made at different growth stages. Farmers' average rates of seeding and applied potassium fertilizer conformed to the recommended ones, but those of applied nitrogen and phosphorus fertilizers were about 60 and 80%, respectively, of the recommended doses. Grain yield varied from 0.83 to 2.34 t/ha and was correlated with numbers of tillers and ears per m^2 at the flowering and maturity stages, respectively. Multiple regression analysis for the grain yield indicates that higher plant density did not always increase the grain yield but that the combination of optimum plant density and more tillers per plant could attain higher grain yield in the surveyed fields in Tangail District.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a new crop in Bangladesh and local scientists have developed a set of new technology for wheat cultivation such as sowing time, seeding rate, fertilization, etc. So the production began to increase since 10 years ago progressively, due to increase in both acreage and yield per unit area (Fig. 1). However, for the past four years the average grain yield has been retarded about 2 tonnes per ha or less than that. Therefore, it is necessary to clear the yield constraints which have retarded grain yield of wheat in farmers' field.

In this study we collected and analyzed data on the cultural situation in the farmers' wheat fields of Tangail, because Tangail is one of major wheat production areas in Bangladesh.

MATERIALS AND METHODS

We selected Tangail District as a surveyed area where is central region of Bangladesh, and located in about 70 km north-west of Dhaka, the capital city. Twenty farmers' wheat fields were surveyed at 8 villages (Tarabari, Charnargabari, Diglapara, Palima, Birsharail, Karatipara, Jigatara and Karua) in Tangail District. Wheat plants in the selected fields were grown under rain-fed conditions in 1987-1988 dry season. Information on farmers' cultural practices (used cultivars, sowing date, seeding rate

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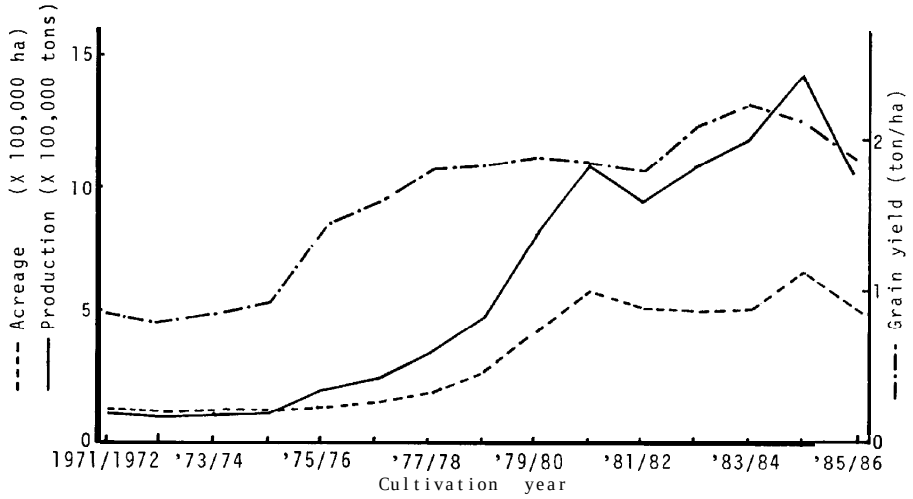

Fig. 1. Yearly changes of acreage, grain yield and production of wheat in Bangladesh. Data from Statistical Pocket Book of Bangladesh, 1986 and 1987.

and fertilization) was collected in the middle of December, 1987 using our predesigned questionnaires. Plant density at the early growth stage was investigated at a 100 cm x 100 cm plot with three replications in a field on Dec. 19 and 20, 1987. When most of wheat fields reached flowering stage (Feb. 9 and 10, 1988), the plants of a 50 cm X 50 cm plot with three replications in a field were taken for determination of numbers of plants and tillers, dry matter production, and N, P and K concentrations in the upper leaves (from flag leaf to the third leaf). Ground material of upper leaves was digested in concentrated H_2SO_4 solution and analyzed for N by semimicro Kjeldahl method. P and K concentrations were determined by spectrophotometer, using vanadomolybdo phosphoric yellow color method, and atomic absorption spectrophotometer, respectively, after the ground material was ashed at 500°C for 5 hours and extracted into 1 N HCl. Around the maturity stage (March 13 and 14, 1988) the plants of a 100 cm × 100 cm plot with three replications in a field were collected for yield analysis from 16 fields, because 4 farmers had harvested wheat plants before our sampling.

RESULTS AND DISCUSSION

Cultural practices adopted by farmers

The most predominant cultivar was Kanchan followed by Sonalica in the surveyed fields, though used cultivars of 8 farmers were unknown (Table 1). A newly released cultivar Agrani was used by two farmers, while an outdated variety Mexipak by one farmer. The earliest and latest sowing dates were Nov. 14 and Dec. 12, respectively. However, more than 60 percents of farmers sown wheat seeds between Nov. 26 and Dec. 4.

Generally farmers broadcast wheat seeds after ploughing a field by cow several times. Thereafter, the field is again ploughed twice and leveled by cow with a local ladder. After 15 to 20 days of emergence the field is raked for weed control in this

Table 1. Used cultivar and sowing date in the surveyed farmers' fields.

	Used cultivar	Sowing date
Farmer	Kanchan (6) *	Earliest Nov. 14
	Sonalika (3)	
	Agrani (2)	Latest Dec. 12
	Mexipak (1)	
	Unknow (8)	
Recommendation**		
	Kanchan	By early December

*Number of farmers who used the cultivar.
**Experimental conditions in demonstration plots conducted by Agricultural Extension Department, Ministry of Agriculture, Bangladesh.

Table 2. Seeding rate and applied doses of N, P_2O_5 and K_2O in the surveyed farmers' fields.

	Seeding rate kg/ha	Applied fertillizer (kg/ha)		
		N	P_2O_5	K_2O
Min.	109	0	25	0
Max.	212	76	97	40
Average	147	37	50	21
Recommendation*	150	60	60	20
r+	0.097	0.134	0.270	0.111

*Experimental conditions in demonstration plots conducted by Agricultural Extension Department, Ministry of Agriculture, Bangladesh.
+Correaltion coefficient with grain yield.

Table 3. Observations at different growth stages in the surveyed farmers' fields.

	No. of plants /m²	No. of plants /m²	No. of tillers /plant	No. of tillers /m²	N^x (%)	P^x (%)	K^x (%)
	Early growth stage			Flowering stage			
Min.	41	77	1.04	152	1.72	0.168	1.55
Max.	258	263	2.43	421	3.29	0.286	3.02
Average	159	172	1.65	256	2.54	0.229	2.14
r+	0.001	0.011	0.366	0.661"	0.276	0.455	0.255

xConcentration in upper leaves.
+Correlation coefficient with grain yield.
*Significant at the 5 % level.

*Comment from staff of On-Farm Research Division, Bangladesh Agricultural Research Institute, Tangail, Bangladesh.

district*. Seeding rate varied from 109 to 212 kg/ha and the average of 147 kg/ha was almost similar to the recommended rate of 150 kg/ha (Table 2). Most of the surveyed farmers applied urea, triple superphosphate and muriate of potash as basal fertilizers prior to sowing, but did not applied any supplemental fertilizer. The amount of applied potassium fertilizer was as large as the recommended dose, while the amounts of applied phosphorus and nitrogen fertilizers were about 80 and 60 percents, respectively, of recommended doses. Studies conducted previously in Bangladesh Agricultural Research Institute showed that wheat plants responded to applied nitrogen and phosphorus fertilizers favorably but not to potassium fertilizer in some districts of Bangladesh (BAR1 1982, 1983).

Observations at different growth stages

Plant density at the early growth stage was investigated about three weeks after sowing (Table 3). It varied from *41* to *258* plants/meter², and the average of 20 farmers' fields was 159 plants/meter². However, the emergence rate estimated from the averages of seeding rate and plant density is less than 50% even if seed size of the sown seeds was estimated as large as 40 g/1000 seeds. The poor emergence or thinned plant density might be due to low viability of the sown seeds and/or poor land preparation in a seed bed by farmers. From our preliminary observations some of sown seeds reached beyond 5 cm depth in the soil. This might be one of the reasons for the poor emergence in the farmers' wheat fields.

At the flowering stage number of tillers per plant varied from 1.04 to 2.43 and the average was 1.65 (Table 3). The highest plant density of 263 plants per meter² did not resulted in the greatest number of tillers per meter², but the combination of 175 plants with 2.40 tillers maximized the number of tillers per meter² to 421, because the plant density at this stage was negatively correlated with the number of tillers per plant ($r = -0.630^*$). Nutritional conditions of the wheat plants at this stage were also different among the farmers' fields. The average concentrations of N, P and K in the upper leaves were 2.5, 0.23 and 2.1%, respectively. N, P and K concentrations in the whole plant of spring wheat which had the highest grain yield in a field experiment in the southern state of USA were 1.83, 0.35 and 2.14%, respectively, at the boot stage (Elwali and Gascho 1985).

Yield **and yield components**

Grain yield varied from 0.83 to 2.34 t/ha, and the average grain yield of 1.59 t/ha

Table 4. Grain yield and yield components in the surveyed farmers' fields.

	Grain yield ton/ha	No. of plants /m²	No. of ears /plant	No. of ears /m²	Seed size g/1000 seeds
Min.	0.83	50	1.12	102	26.9
Max.	2.34	214	2.67	284	41.0
Average	1.59	118	1.84	200	34.5
r+	···	0.103	0.352	0.605*	0.109

+Correlation coefficient with grain yield.
*Significant at the 5% level.

Table 5. Multiple regression for the grain yield in the surveyed farmers' fields.

$Y = -2.76 + 0.347X_1^2 + 0.0322X_2 - 0.0000716X_2^2$
Y = Grain yield (ton/ha)
X_1 = No. of tillers/plant at flowering stage
X_2 = No. of plants/m^2 at flowering stage
F value= 6.68"
R^2 ajusted for the degrees of freedom= ***0.532***

**Significant at the 1% level.

was less than national one in 1985-86 (Table 4 and Fig. 1). Yield components also showed large variation but only the number of ears per $meter^2$ was significantly correlated with grain yield.

Correlation coefficients between grain yield and cultural practices, or observations at different growth stages were also shown in Tables 2 and 3. Only number of tillers per $meter^2$ at the flowering stage was significantly correlated with grain yield. The correlation coefficient with P concentration at the flowering was the second highest of our observations, though not significant. Batten *et al.* (1986) indicated that the higher phosphorus supply produced larger plants with more tillers per plant in the nutrition culture. Koseki (1977) reported that phosphorus deficiency in plants enhanced the dry matter reduction of forage crops subjected to water stress.

Multiple regression analysis was done for the identification of factors to explain the variation of grain yield (Table 5). When numbers of tillers per plant and plants per $meter^2$ at the flowering stage are selected as independent variables out of all the variables shown in Tables 2 and 3, R^2 (multiple regression coefficient adjusted for the degrees of freedom) is the highest and F value also indicates the significant fitness of the regression at the 1% level. This multiple regression analysis indicates that higher plant density did not always increase grain yield but that the combination of optimum plant density and more tillers per plant could attain higher grain yield in the surveyed wheat fields in Tangail.

ACKNOWLEDGEMENTS

We received generous assistance from the field staff of On-Farm Research Division of BARI, Tangail during the course of this study for which we express our sincere appreciation. Agricultural Extension Officers of Ghatail, Kalihati and Bhuapur Upazillas established the demonstration plots from where we have drawn heavily. This study was also supported by the Japan-Bangladesh-United States Technical Cooperation Project. We express our sincere appreciation to all persons concerned with this project, especially Japan International Cooperation Agency (JICA), the major donor of the project.

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