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EFFECT OF TYPES OF SEEDLING NURSERIES ON THE GROWTH-PHASE DURATION IN TEN RICE CULTIVARS GROWN AS TRANSPLANT AUS RICE

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Seedlings of ten different rice cultivars, namely, Dharial, Kataktara, Charnock, Dular, Marichbati, MIFB-322-1, Taichung (native) 1, IR8, IR5, and Peta were raised in three different types of seedling nurseries, 'normal', 'dapog', and 'floating; and the effect of types of seedling nurseries on the different phases of growth and their durations in transplant *aus* rice were studied. Five growth phases, viz. germination phase, active vegetative phase, lag-vegetative phase, active reproductive phase, and grain development and ripening phase, were recognized in IR5 and Peta only. The lag-vegetative phase was found absent in other eight cultivars. The floating nursery seedlings completed their active vegetative phase about a week earlier than the seedlings from the other two types of nurseries. The length of the total growth duration of floating seedlings was also 4 to 5 days shorter than those of seedlings of the other two types of nurseries. There was no practical difference between normal and dapog nurseries. The ten cultivars under study varied significantly in the durations of their different growth phases as well as in their respective total growth durations. The duration of the active vegetative phase appeared to be directly proportional to the length of the total growth duration, or vice versa. The total growth durations of the exotic cultivars were, in general, longer (121-176 days) than those (106-118 days) of the local ones.

For scientific culture of a crop, a thorough knowledge about the different phases of growth that the crop completes its life cycle through is essential.[11,12] Judicious and timely application of fertilizers, irrigation, weed control, and other intercultural operations are possible only when the different growth phases of the crop and their durations and requirements are well determined.

Different workers have reported variously named different phases of growth in rice. Some workers[3,10] have recognized only two phases of growth in the life of a rice plant, while others[20,21] have divided the entire life cycle into three phases, and still others[2] have reported four growth phases in rice plants. Mian *et al.*[11,12] have recognized in rice five growth phases, namely, germination phase, active vegetative phase, lag-vegetative phase, active reproductive phase, and grain development and ripening phase.

Although *aus* rice is grown in East Pakistan mainly as a broadcast-sown crop, transplantation is followed[1] on a limited scale in the districts of Sylhet, Chittagong, and Dacca. Experimental evidence[4,5,11,12,13,15,17,18] indicates that, with irrigation facilities available, transplant rice crop yields higher than does a broadcast crop. Now, rice seedlings for transplantation may be raised in different types of seedling nurseries. Effect of different types of seedling nurseries on the performance of rice crop has been reported elsewhere.[14] In the present paper is reported the effect of different types of seedling nurseries—normal, dapog, and floating—on the duration of different growth phases as well as on the total growth durations of ten local and exotic cultivars (varieties) of rice. In the present study, the different growth phases will be as reported by Mian *et al.*[11,12]

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory of the East Pakistan Agricultural University, Mymensingh, during the period from April to October 1968. The experimental plot belonging to the Brahmaptura alluvial soil tract[8] of the province was a medium high land. The soil was silty loam in character having a pH of 6.6–6.8. The total rainfall received at the experiment station during the said period was 67.57 in. The daily maximum and minimum relative atmospheric humidity were 89.66 and 56.25% respectively, and the monthly average day lengths during April to October were 12.55, 13.10, 13.40, 13.30, 12.85, 12.22, and 11.52 hr respectively.

Seedlings of five local rice cultivars (varieties), namely, Dharial, Kataktara, Charnock, Dular, and Marichbati, and 5 exotic cultivars—MIFB-322-1, Taichung (native) 1, IR8-288-3, IR5-47-2, and Peta—were raised in three different types of seedling nurseries, normal, dapog, and floating and transplanted in the main field at the age of 26 days.

Normal seedling nursery was prepared in 23 in. diameter drums. For this purpose the drums were filled with loamy soil which was compacted well except for the upper 6 in. of soil. Each of the drums was fertilized with urea, treble superphosphate, and muriate of potash to apply 28 lb N,

12 lb P (element), and 30 lb K (element) per acre in addition to 4.4 tons of cowdung per acre on the basis of the surface area of land in a drum. The cowdung was applied 7 days before sowing and the fertilizers were applied 2 days before sowing the seeds in the nurseries. The manure and fertilizers were thoroughly mixed up with the upper 6 in. of soil. The seeds, sprouted over a period of 3 days, were sown in the well-prepared nurseries on 25 April 1968. The seeds were covered with a thin layer of pulverized soil to prevent drying.

For raising seedlings in dapog nursery, a flat compact bed was prepared with soil at a height of 2 in. from the ground level which was covered by a polyethylene sheet. The polyethylene sheet was kept in position by fixing small bamboo pegs along the sides of the bed. Three-day sprouted seeds were then sown thickly on the bed thus prepared. The seeds were kept moist by sprinkling water with hand and protected from the scorching sun by providing a removable shade. The seedlings were pressed lightly with hands for the first few days to keep the roots of the seedlings in contact with the polyethylene sheet so that they could absorb necessary moisture from it. No manure and fertilizer were applied in this seedling nursery.

For preparing a floating nursery, a frame was made with bamboo matting which was kept floating on some pieces of banana stem on water in a pond. The frame was plastered with mud (1.5 in. thick) to make a bed. Three-day sprouted seeds were then sown on the bed. No manure and fertilizer were applied in this nursery.

The experiment was laid out in split-plot design with cultivars in the main plots and the seedling nursery types in the unit plots, the net size of each unit plot being $\frac{1}{581}$ acre. The experiment was replicated three times. The experimental plots were fertilized with urea, treble superphosphate, and muriate of potash to apply 47 lb N, 20 lb P (element), and 40 lb K (element) per acre in addition to 1.8 tons cowdung per acre. Half of the urea and the whole of treble superphosphate and muriate of potash were applied one day before transplanting and the remaining half amount of urea was top dressed at the panicle initiation stage[11] of the crop plants. Transplantation of 26-day old seedlings was done on 18 May in straight rows at a spacing of 10 in. × 10 in. with two seedlings per hill.

The experimental plots were studied for the following aspects: (1) duration of germination phase, (2) duration of active vegetative phase, (3) duration of lag-vegetative phase, (4) duration of active reproductive phase, (5) duration of grain development and ripening phase, and (6) the total growth duration.

In each unit plot ten hills were selected at random at the early stage of plant growth. The data, regarding the duration of different phases, except the duration of germination phase which was studied in the nursery, were collected from those selected hills and analysed statistically.

Results and Discussion

The effect of types of seedling nurseries on the five different growth phases as well as on the total growth duration of the different rice cultivars under study has been presented in Fig. 1. Given below are the phase-wise discussion of results.

Germination Phase.—Twenty-two-hour water-soaked (completely submerged under water)

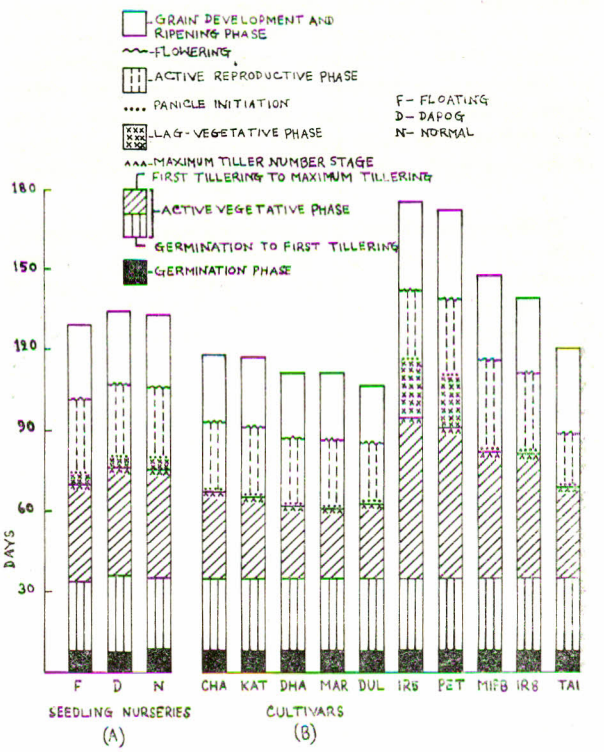

Fig. 1.—(A) Influence of seedling nurseries on the durations of the different growth phases and the length of the total growth duration in ten local and exotic rice cultivars grown as transplant *aus* rice in East Pakistan. (B) Duration of different growth phases and the total growth durations of ten local and exotic rice cultivars grown as transplant *aus* rice in East Pakistan. Local cultivars: CHA—Charnock; KAT—Kataktara; DHA—Dharial; MAR—Marichbati; DUL—Dular. Exotic cultivars: IR5—IR5-47-2; PET—Peta; MIFB—MIFB-322-1; IR8—IR8-288-3; TAI—Uaichung (native)1.

seeds began sprouting after 46 hr of putting the seeds to soaking and they completed sprouting within 24 more hours.

Germination phase, in the growth of a rice plant, began from the day the seeds were soaked in water and ended with the completion of emergence and rupture of coleoptile and putting forth of the primary leaves. From Fig. 1 it will be seen that the duration of the germination phase in Dapog and floating types of nurseries were approximately the same (7.5 and 7.7 days respectively) while the normal type of nursery took approximately one day more than did the other two types of nurseries. The reason for this delay was due possibly to the fact that in normal nursery the germinating seeds had to pierce through a layer of about half-inch thick soil overlying the seed, while the seeds in the other two types of nurseries were just on the surface of the beds.

So far as the different cultivars were concerned, there was almost no difference in the duration of the germination phase (Fig. 1).

Active Vegetative Phase.—The period from the end of the germination phase to the maximum shoot-number stage was considered to be the active vegetative stage. High rate of vegetative growth and putting forth of all the shoots of a plant were the characteristic features of this phase in the growth of rice plant.

Figure 1 clearly shows that the nursery types very significantly influenced the duration of this phase. The duration of this phase was longest in dapog (68.60 days) and shortest in floating (62.93 days) nurseries. The difference in moisture and plant nutrient supplies to the growing seedlings in the three nursery types might be the possible reasons for these differences. Seedlings in the floating nursery were supplied with necessary nutrients (as the seedlings were growing on a layer of soil) and moisture. As a result, possibly, these seedlings could grow vegetatively with higher growth-rate than the seedlings on any of the other two nursery types. Consequently these seedlings could possibly initiate tiller (shoot) growth earlier and hence could complete it earlier, than those in the other types of seedling nurseries. In the normal nursery, lesser water-supply than in 'floating' nursery might be the reason for the longer duration of the active vegetative phase as compared to that of the seedlings of the floating nursery. In dapog nursery, lack of plant nutrients as well as lack of root-room were evidently responsible for the slowest vegetative growth-rate and for slowest rate of putting forth of all their tillers.

The ten cultivars tried also varied significantly in the duration of their active vegetative phase. With the exception of Taichung(n)1, the duration of this phase in the exotic cultivars were significantly longer than those of the local cultivars. One very interestingly imprtant point may be noticed here that the duration of the active vegetative phase of a cultivar is well-associated with its total growth duration. With a few exceptions, the longer the duration of this phase, the longer is the total growth duration, or vice versa.

Lag-vegetative Phase.—The short (sometimes totally absent) period between the maximum-shoot stage and the panicle-initiation stage was conceived of as the lag-vegetative phase. This phase represents, so to say, a pause or transition from vegetative growth phases to reproductive growth phases. Tiller mortality is a characteristic feature of this phase of plant growth in rice. Seedling nurseries did not have any effect upon the duration of this phase.

The cultivars of rice varied very significantly in the duration of their lag-vegetative phase (Fig. 1). None of the local cultivars and three other cultivars, except IR5 and Peta, did exhibit this phase at all. This means that in these cultivars plants enter into the active reproductive phase right after completing their active vegetative phase. Comparatively the short-duration cultivars did not exhibit lag-vegetative phase. Of the ten cultivars included in the present study, only IR5 and Peta exhibited this phase of growth. In a sense, this lag-vegetative phase may be regarded as a phase of idling of rice plants. On reference to the total growth durations of these two cultivars (IR5 and Peta) it will be very clearly seen that these two cultivars are comparatively long duration ones when compared to the rest, and the presence of the long (20 to approximately 22 days) lag-vegetative phase is one of the most important factors that contributed to the excessively longer total growth durations in these two cultivars. If, in any way, this lag-vegetative phase in the growth of these two cultivars could be knocked off, their total growth durations could be considerably reduced.

Active Reproductive Phase.—The period from beginning of panicle initiation to completion of flowering was recognized as the active reproductive phase. Although the influence of seedling nursery types on the duration of this phase of growth was statistically significant, the extent of variation (less than a day) was very little for all practical purposes (Fig. 1). The different cultivars, however, showed significant and considerable variation in the duration of their respective active

reproductive phase. This duration being longest (33.89 days) in MIFB-322-1, it was shortest (19.78 days) in Taichung (n)1.

In the life of a rice plant active reproductive phase is a very critical stage. Statisfactory grain production considerably depends upon the crop management during and immediately prior to this phase. Rice crops require plenty of water at the booting stage.[17] Satisfactory grain yield can be obtained if the crop is top-dressed with nitrogenous fertilizer at the panicle initiation stage.[19] On the other hand, a deficiency of nitrogen at the ear primodia initiation stage have been found to have the greater depressing effect on the grain yield of rice.[7] This is a period during which the rice plants should not be disturbed and, therefore, manuring and all other intercultural operations should be completed before the crop plants enter this phase.

Grain Development and Ripening Phase.—From the end of flowering to the maturity of rice grain was the period of growth that was termed the grain development and ripening phase. Here also, although the influence of nursery types on the duration of this phase was statistically significant, the extent of this variation (less than a day) was very much negligible for all practical purposes.

The cultivars, however, varied in the duration of this phase significantly. IR5 possessing the longest duration (33.89 days) of this phase, Dular exhibited the shortest (21.33 days) grain development and ripening phase. With one or two exceptions, the duration of this phase seems to be more or less directly correlated with the total growth duration of the cultivars studied.

It may be mentioned that water management in the crop field is of special importance in this phase of growth. To encourage uniform ripening of rice grains, water needs to be drained out of crop field usually about 2 weeks before harvesting of the crop.[17]

Total Growth Duration.—The total growth duration of a rice cultivar is the total duration of all its growth phases from seed to seed. Total growth duration of a cultivar is an important factor to be considered by the growers. It determines whether a particular rice cultivar can be profitably grown in a particular place without affecting the crop to follow in the rotation or cropping pattern.

Both the seedling nurseries and the cultivars had significant effect on the length of total growth duration (Fig. 1) Although each of the three seedling nurseries statistically differed from one another in respect of the total growth duration, there was not much of practical difference between dapog and normal. Floating nursery, however, reduced the length of total growth duration by about 4–5 days in comparison to the other types of seedling nurseries. It was reported[9] that the total growth duration of rice plants was 15–22 days less with dapog nursery seedlings than with those of normal nursery. In the present experiment the total growth duration in the dapog nursery seedlings was statistically longer than that of the normal nursery seedlings although, as pointed out earlier, the difference was very negligible for all practical purposes. The prolonged nursery period (26 days) was probably the reason why dapog seedlings could not reduce the length of total growth duration from that required by normal seedlings. It was stated[9] that the dapog seedlings become suitable for transplanting at the age of 9–12 days and any prolongation of nursery period might depreciate the value of the seedlings. Pande and Mitra[16] reported that dapog seedlings of 12–14 days should be transplanted. There was another report[6] that dapog seedlings should be transplanted within 2 weeks after germination. But in the present experiment the seedlings were transplanted at the age of 26 days which, perhaps, might be responsible for the longer total growth duration in the dapog nursery seedlings than that of the normal seedlings.

A very important point may be noticed that the total growth duration in different cultivars varied directly with the length of the active vegetative phase (Fig. 1) with a few exceptions. The total growth durations of the exotic cultivars were longer than those of the local ones. In respect of the length of total growth duration, there were six different groups among the cultivars, the cultivars in a group being statistically identical. The groups in order of total growth duration length were IR5 and Peta; MIFB-322-1; IR8-288-3; Taichung (native)1, Charnock, and Kataktara; Charnock, Kataktara, Dharial, and Marichbati; and Dharial, Marichbati, and Dular.

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