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Studies on Age of Seedlings in Ragi - *Eleusine coracana* (Gaertn)

by

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Introduction: Among the millets *ragi* (*Eleusine coracana* Gaertn.) which tillers profusely is invariably transplanted when grown as an irrigated crop. The period to which seedlings are allowed to remain in the nursery depends upon the variety and its duration. As a thumb rule *ragi* cultivators allow a nursery period of one week for every month of the duration of the crop. Overaging of seedlings in nursery is considered to result in reduced returns. Since the care of the nursery is easy and economical, information on the optimum and maximum periods the seedlings may be allowed to remain in nursery are of immense benefit to the cultivators. Detailed information on the influence of age of *ragi* seedlings at the time of transplanting on yield and other important quantitive aspects are presented in this article.

Broadcasting *versus* transplanting experiments with rice varieties of different duration conducted in Madras State showed that transplanted rice gave a better yield (K. Ramiah et al, 1936). Similar experiments on millets showed that transplanting do not improve the yield of cholam whereas the practice increased the yield of *cumbu*, *ragi*, and lesser millets (Anon, 1962, Appala Naidu et al 1959). These observations conform to the contention that cereals which tiller freely respond to transplanting.

Age of seedling experiments on rice were conducted by the Agricultural Department in several of its Rice Research Stations (K. Ramiah et al 1936 to 1937). The general conclusion tend to show that it is advisable to transplant seedlings as early as possible on the basis of one week in the nursery for each month of the duration of the crop, However there was no great harm in keeping the seedlings upto 60 days in the nursery provided they do not form nodes. But in the garden land crop of *ragi* overaging of seedlings reduced yield. Earlier trials on age of seedlings conducted at Agricultural Research Station, Anakapalli indicated thatseedlings of 14–28 days could be planted without making any appreciable difference in yield. Later experiments with three popular strains of *ragi* indicated that early varieties require only a shorter period in nursery as compared to late varieties (K. Divakaran, 1966).

Materials and methods: Information on the optimum age of ragi seedlings in days at the time of planting in order to obtain the highest yield and the influence of seedlings' age at planting on the performance of the crop was gathered by field experiments at the Millets Breeding Station, Coimbatore during the main season of 1954 and 1955 with three popular varieties of *ragi* viz. Co. 1 of 120 days (medium duration) Co. 2 of 110 days (Short duration) and Co. 7 of 100 days (early duration). Seedlings were raised in well prepared

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nurseries with usual care and attention and transplanted when they were 20, 25, 35, 40 and 45 days old. Two methods were adopted for obtaining seedlings of the required ages at transplanting. They were (i) sowing the seeds on the same date and transplanting the seedlings at appropriate ages and (ii) staggering the sowing dates such that seedlings of required ages were available on the same day for planting. Each of these was called a series and each series was studied under a separate experiment. Thus there were four experiments. The trial was laid out in split plot design with four replications alloting ages to the main plots and varieties to the sub plots.

Yield data of both grain and straw were recorded plot wise. Measurable morphological characters namely, plant height, number of tillers, number of leaves, panicle length and number of fingers were recorded on a random sample of 10 plants per plot. Data for yield and other characters were analysed statistically by the method of analysis of variance and comparison of means made wherever appropriate. Pooled analysis of grain and straw yield over the two years was conducted.

A trend curve was fitted for the mean yields of grain under the different ages of seedlings at transplanting for purpose of determining the optimum age of transplanting if possible. The method adopted for this was that of fitting orthogonal polynomials given by Fisher (1938).

Experimental results: *Yield:* The summary of results of statistical analysis of grain and straw yield of *ragi* Co. 1, Co. 2 and Co. 7 grown under the two methods of age adjustment for the two years are as follows:

1954: In series one with same date of sowing and different dates of planting 30 days old seedlings were the best in grain yield.

Ragi Co. 7 seedlings of 30 days gave the highest yield, the reduction in yield being very marked with 40 and 45 days old seedlings. Among the varieties, Co. 2 and Co. 7 were on par and superior to Co. 1. The response of grain yield to age of seedlings was more marked in Co. 7 than in the other two strains. In straw yield no significant difference due to age at planting was noticeable though younger seedlings gave a better yield.

In series two sown staggered and planted on the same date differences in grain yield due to varieties or age of seedlings at planting was hardly perceptible. However Co. 1 and Co. 7 showed a preference for younger seedlings whilst Co. 2 showed a preference for older seedlings. The same trend was discernible in straw yield also.

1955: In the first method of age adjustment of seedlings i. e. sown on same date and planted at the required ages, seedlings of 25 days recorded the highest grain yield whilst seedlings of 40 and 45 days gave markedly reduced yields. The strain Co. 2 recorded the highest yield. In straw yield seedlings of 25 and 20 days were in general found to be superior to 35 to 45 days old seedlings in all the strains. Strain Co. 1 was the best yielder of straw.

Under the second method of age adjustment of scattered sowing and single day planting no significant differences in grain yield was observable among varieties and ages of seedlings. The same trend was observable in straw yield. Among the strains Co. 1 gave the highest yield of straw

Pooled analysis : The results of pooled analysis of grain yield over the two years 1954 and 1955 with two series each year are presented in Table I

TABLE 1

Summary of Results : Pooled analysis — Mean grain weight in lb. per plot

(i) *Method of age adjustment (series* I *and* II*)*

Year	Series I	Series II	S. E. of mean	C. D. (P=0·05)	Conclusion
1954	2·815	2·683	0·209	0·630	I II
1955	5·805	4·914			

(ii) *Ages of seedlings and varieties :*

Variety / Ages of seedlings	20 days 1	25 days 2	30 days 3	35 days 4	40 days 5	45 days 6	Mean
Ragi Co. 1	3·381	4·230	4·384	4·316	3·729	3·919	3·993
Ragi Co. 2	4·537	4·258	5·008	4·316	4·213	3·255	4·235
Ragi Co. 7	4·906	4·523	4·281	4·698	2·998	2·209	3·936
Mean	4·275	4·337	4·557	4·383	3·647	3·128	—

	S. E.	C. D. (P=0·05)
Means of varieties	0·067	0·185
Means of age of seedlings	0·103	0·291
Difference between means of any two ages under any one variety	0·238	0·469
Difference between means of any two varieties at any one age	0·234	0·452

Conclusions :

1. Years — 1955 1954
2. Series within years — 1954 I II; 1955 I II
3. Ages of seedlings — 3 4 2 1 5 6
4. Varieties — Co. 2 Co. 1 Co. 7
5. Ages × Varieties

(i) *Ages Varieties*

1. Co. 7 Co. 2 Co. 1
2. Co. 7 Co. 2 Co. 1
3. Co. 2 Co. 1 Co. 7
4. Co. 7 Co. 1 Co. 2
5. Co. 2 Co. 1 Co. 7
6. Co. 1 Co. 2 Co. 7

(ii) *Varieties Ages*

Co. 1 3 4 2 6 5 1
Co. 2 3 1 2 5 4 6
Co. 7 1 4 2 3 5 6

The results show that the overall performance was better in 1955 than in 1954. It was also seen that while in the first year the two methods of age adjustment of seedlings were on par, in 1955 the first method of sowing on the same date and planting in instalments at the appropriate ages was superior to the second method of staggered sowing and planting on the same date. As regards age of seedlings the advantage of transplanting seedlings within the ages of 20–35 days and the undesirability of using 40–45 days seedlings have been clearly brought out. The variety Co. 2 was better than the other two strains which were on par. The selective preference of strains to seedlings of different ages was also in evidence with Co. 7 showing consistant preference for 20 days though on a par with ages upto 35 days, Co. 2 recording the best performance with seedlings of 30 days and Co. 1 with seedlings of 25–35 days.

To determine the optimum age of transplanting a trend curve was fitted for mean grain yields. As response of grain yield to ages of seedlings at transplanting was not only different but also not quite constant, it was thought desirable to fit a response curve for each year of trial taking the average of the two methods of age adjustment as mean response. In neither of the years an appropriate fit was obtained. Next the average response for each method of age adjustment over the two years was computed and a response curve was worked out for the two methods. It was seen that a curve of the second degree (quadratic) was the best fit for the first method of one sowing date and staggered planting.

Response curve: $Y = 3{\cdot}9392 + 0{\cdot}1757 - 0{\cdot}007x^2$

Optimum value of $\times = 32{\cdot}37$ or 32 days.

From the response curve so obtained the optimum age of ragi seedlings at transplanting arranged over all the three strains under trial was found to be 32 days after sowing.

In the other method of age adjustment with different dates of sowing no consistant pattern of response to age of seedlings at transplanting was obtained.

The results of pooled analysis of straw yield over the two years 1954 and 1955 are presented in table 2.

TABLE 2

Summary of results: Pooled analysis—Mean straw weight in lb. per plot.

(i) *Method of age adjustment (Series I and II).*

Year	Series I	Series II	S. E. of mean	C. D. (P=0·05)	Conclusion
1954	13·061	13·061	1·655	4·990	I II
1955	29·232	16·316			

TABLE 2 *(Contd.)*

(ii) *Age of seedling and varieties:*

Varieties/ Age of seedlings	20 days 1	25 days 2	30 days 3	35 days 4	40 days 5	45 days 6	Mean
Ragi Co. 1	22·859	26·375	23·110	23·961	19·234	15·307	22·322
,, Co. 2	18·891	17·965	20·422	17·813	18·578	11·964	17·608
,, Co. 7	20·016	16·852	14·891	15·156	10·250	6·064	13·871
Mean	21·588	20·398	19·441	18·977	16·021	11·144	...

	S. E.	C. D. (P=0·05)
Means of varieties	0·416	1 152
Means of age of seedlings	0·769	2·174
Difference between means of any two ages under any one variety	1·978	3·169
Difference between means of any two varieties at any one age	1·440	2·823

Conclusions:

1. Years — 1955 — 1954
2. Series within years — 1954 — I II; 1955 — I II
3. Age of seedlings — 1 2 3 4 5 6
4. Varieties — Co. 1 Co. 2 Co. 7
5. Age × Varieties

(i) *Age* — *Varieties*

1. Co. 1 — Co. 7 Co. 2
2. Co. 1 — Co. 2 Co. 7
3. Co. 1 Co. 2 Co. 7
4. Co. 1 — Co. 2 Co. 7
5. Co. 1 Co. 2 Co. 7
6. Co. 1 Co. 2 Co. 7

(ii) *Varieties* — *Ages*

Co. 1 — 2 1 4 3 5 6
Co. 2 — 3 1 5 2 4 6
Co. 7 — 1 2 4 3 5 6

The same trend as in grain yield was reflected in straw yield. Every successive increase of five days in the age of seedlings resulted in a small reduction in straw yield. It was observed that while 20–30 days old seedlings were on par, 20 days seedlings were surpassingly better than 35-45 days old seedlings. The strain Co. 1 was the best and Co. 7 recorded the least yield of straw. For Co. 7 the best age for transplanting was 20–25 days and 25–35 days for Co. 1 while Co. 2 responded more or less alike to seedlings of all ages.

Plant characters: The effect of age at the time of planting on important morphological characters were studied for the two series of experiments in 1955. The characters studied and their response to age of seedling at planting were:

1. Plant height: Seedlings of 20–30 days recorded the best growth. Strain Co. 1 recorded the greatest height and Co. 7 the least with Co. 2 coming in between.

2. Number of tillers: Older seedlings of 35–45 days recorded greater tillering activity than younger seedlings of 20–30 days. Strain Co. 7 recorded the maximum tillering followed by Co. 2 and Co. 1 which were on par.

3. Number of nodes: Seedlings of 30–35 days had the same number of nodes whilst there was a significant reduction in seedlings of 40–45 days. This influence was clear in all the strains. Strain Co. 1 recorded less number of nodes than Co. 2 and Co. 7 which were on par.

4. Number of leaves: The number of leaves followed almost the same trend as nodes in regard to age of seedlings.

5. Panicle length: In all the strains seedlings, of 30 days recorded greater panicle length than seedlings of other ages. The strain Co. 1 had the longest panicle, Co. 2 the shortest and Co. 7 coming in between.

6. Number of fingers: Seedlings of 20–30 days old recorded the largest number of fingers. The number of fingers seem to decrease with every successive increase in age of seedlings. The order of strains with regard to number of fingers were Co. 2, Co. 7, Co. 1.

Though the effect of the age of seedling at planting time on growth of the crop appear to be similar i. e. earlier seedlings performing better it is more profound and clear in Co. 7 than Co. 2 and Co. 1. The impact of the age of seedlings on the subsequent growth is illustrated in figure 2.

Summary and Conclusion: The effect of planting 20, 30, 35, 40 and 45 days old seedlings of three popular varieties of *ragi* Co. 1, Co. 2 and Co. 7 were studied. The grain and straw yield reveal distinct influence of age of seedlings at the time of planting. Younger seedlings were preferable to older ones. This trend both in regard to grain and straw yield were brought out more clearly in series one sown on the same date and planted at the appropriate ages than in series two sown scattered and planted on the same date. The response of age of seedlings is fairly clear in all the three varieties but it was quite marked in the case of Co. 7. The impact of age of seedlings on the yield components were also investigated. The characters, plant height, number of tillers, nodes and leaves, length of panicle and number of fingers followed the same trend as yield in relation to age of seedlings. Older seedlings showed a tendency for more tillering. It would appear that young seedlings of 20–30 days gave the best yield.

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Book Review

"INTRODUCTION TO CYTOGENETICS AND PLANT BREEDING"

by D. Daniel Sundararaj and G. Thulasidas.,
Popular Book Depot, Madras.
Rs. 10—00

Agricultural undergraduates in this region have long felt the need for a manual on Cytogenetics and Plant Breeding that will suit their standard and purse. Books already available were usually of a much higher standard than needed for an undergraduate and were costly too. Most of those were written by foreign authors and the organisms chosen by them to illustrate genetic principles were usually unknown to our students. On the other hand, the authors of the book under review have utilised wherever possible, indigenous material for illustrations.

One of the merits of this book is the profusion of line drawings. These will greatly help the students especially in understanding the intricacies of chromosome behaviour under different contexts A whole chapter has been devoted to hybrid vigour, which is fully justifiable in view of the ever increasing importance of hybrid varieties. In this and in other aspects. the authors have taken care to be up-to.date. The glossary at the end is comprehensive. The book is moderately priced. The authors deserve all praise for this very worthy piece of work. The students of Agriculture to whom authors have dedicated the book, will no doubt greatly appreciate its value and be benefitted by using it.

The value of this manual as a text book, will be enhanced considerably by the additfon of a few problems at the end of each chapter. The role of the National Seeds Corporation in the spread of improved varieties deserves a place in the book. A few minor defects such as the rare misprinting of spellings and the topsy turvy position of Fig. 90 could have been avoided by closer proof reading. I am sure the authors will take care of these in the next edition.

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