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Evaluation of Seedling Characters on Perennial Ryegrasses

Süleyman Sengül

Atatürk University, Faculty of Agriculture, 25240, Erzurum, Turkey

Abstract: Evaluation of seedling characters on perennial ryegrasses studied of different parental plants for seed multiplication. There is a significant difference between germination percentages on different parental groups, which indicated that two parental plants represent at this experiments had lower germinations than the other parental groups. Eight parental plants represent significantly lower dry weights, and higher coleoptile's numbers were recorded on four parental plants. There is a positive significant correlation (0.887**) between coleoptiles numbers and numbers of inflorescences and also seedling yields (0.917**).

Key words: Parental numbers, *Lolium perenne*, seedling yield, germination

Introduction

Population shift is undoubtedly the most serious hazard during seed production from perennial forage crops, where survival and herbage production under grazed conditions depend on characters which are the antithesis of those characters needed for good seed production (Breese and Tyler, 1981). They reported that potentially valuable ecotypes (land races) of leafy, persistent pasture type perennial ryegrass, showed rapid shift to stem and short-lived types in early attempts to commercialize through seed production. However it is essential that characterization or preliminary evaluation of genetic resources be attempted, as this is the stage when its breeding potential realized.

Population size often has to be reduced during seed regeneration due to limitations in personnel and availability of resources. In this situation gene and genotypic frequencies can be subjected to random fluctuations as a consequence of gamete sampling. The final result of random genetic drift related to small population size is the fixation of alleles. This effect often takes several generations, but rapid fixation could occur by chance. This can cause (1) formation of sub-populations, (2) erosion of genetic variation, and (3) increase of homozygote frequencies (De Pace *et al.*, 1982). Breese and Lewis (1959) worked on the effect of varying the numbers of parent plants on the behavior of synthetic varieties. By selecting for combining ability amongst the initial seven parents it was possible to reduce the number of basic plants to two without any sacrifice in final yield. The results, in so far as the hay cut was concerned, conclusively demonstrated that the most efficient number of plants for a synthetic variety is considerably less than was originally thought desirable. This provides possibilities not only of exercising a more rigorous selection, but also of reducing the time and labor involved

in the maintenance of basic plants.

Breese and Tyler (1981) considered regeneration by random inter pollination among a representative sample of individuals from a population. Integrity of the population is preserved by. 1. Avoiding contamination from foreign pollen by isolation. 2. Avoiding random drift by using a sufficient number of basic plants. 3. Ensuring random mating. 4. Avoiding shift through natural selection, particularly for superior seed production. 5. Ensuring maximum yields of high quality seed so as to reduce the number of subsequent regenerations and to minimize the above risks.

Maintenance of seed collections with a high viability, and multiplication of this seed for the development of new cultivars are very important, and it is the study of these activities with which the following investigations are concerned. An understanding of the control of variation within population is a prerequisite to establishing guidelines for the regeneration of seed stocks. The principles involved in terms of the maintenance of variability will be considered from both theoretical and practical aspects (Tyler 1984).

The optimum conditions for germination must avoid selection due to some seeds failing to germinate and must also ensure uniform seedling development. The necessary conditions may involve alternating temperatures or a period of low temperature treatment before placing the seeds at a temperature suitable for germination (Hayward and Bean, 1984).

Several studies have been conducted to determine the optimum number of parents to intermate to maximize forage yields in a synthetic. In general, the highest yielding experimental synthetic cultivars had greater than four but fewer than 16 parents (Hill and Elgin, 1981; Kidwell *et al.*, 1999).

Using very large numbers of individual plants involves

more time and also labor in the production and maintenance of the basic plants. The aim of this study was to determine whether using different numbers of parent plants for first generation seed production had any effect on the vigor of seedling growth.

Materials and Methods

Seed production and seed characters: Sixty-two spaced plants of Ba.9436 (*Lolium perenne*) were taken at random from a shallow box of soil in an unheated glass house. They were then transplanted to 18 cm diameter pots of soil and over wintered in an unheated isolation glass house.

Finally, they were divided at random into five groups of 2, 4, 8, 16 and 32 plants, which were considered as the parental populations. Then each of the parental groups were transferred to a separate glass isolation compartment just before anthesis and all plants were kept well watered to ensure moisture deficiency did not effect seed setting. They were removed at seed ripeness.

Seed was harvested when it was considered to be ripe as indicated by the loss of chlorophyll from the rachis. Each population was threshed by hand, dried and recorded seed weighed in the laboratory.

Measurements of the following seed production characters were then made on each of the five groups seed weight of plants, inflorescence number and seed weight per inflorescence.

Germination tests were made on the seeds five months after harvest over the intervening time they had been stored in paper packets in laboratory conditions. Germination of each of the five populations was determined by placing fifty seeds in ten replicates on a filter paper disc in a Petri dish in an incubator at 25°C. Germination percentage was determined by counting seeds after two days and the total germination percentage was determined from the number of seeds germinated at seven days transformed anova also uses 3, 4, 5, 6 days (inappropriately). Final data were transformed to angles and analysis of variance was made on this data.

Results

Seed yield, inflorescence number and seed yield per inflorescence number were presented in Table 1. The analysis of variance of germination percentage of different parental plants are shown in Table 2 and the analysis of variance of transformed data (Table 3) showed that there were highly significant differences ($P < 0.001$) between parental plants and also significant differences between germination days and D x P interactions. First day parent plants 2 and 4 had higher germinations than the others but after seven days results showed that 2 parent plants

Table 1: Inflorescence numbers, seed yield per plant and seed yield per inflorescence from different parent plants

Items	Number of parent plants				
	2	4	8	16	32
Seed yield g plant ⁻¹	1.208	1.788	1.788	1.827	1.488
Seed yield/inflorescence (mg)	42	32	51	49	40
Number of inflorescence	29	47	35	38	37

Table 2: Germination percentages of different parent plants of Ba.9436

Parent No.	2	3	4	5	6	7 days
2	18	58	60	61	62	62
4	21	83	90	92	93	93
8	5	44	75	82	84	88
16	7	60	87	93	93	95
32	7	54	81	90	91	93
Mean	12	60	79	84	85	86

Table 3: Variance analysis of transformed Data on germination percentage from different parent plants

Item	df	MS
Total	299	
Reps	9	296.428***
Days	5	13510.365***
Parent groups	4	3865.840***
DxP	20	775.706***
Error	261	32.290

was much lower (62 %) and 16 parent plants was higher (95 %) than the others.

Mean seed yield per plant showed (Table 1) that 2 parent plants was lowest (1.208 g) and 16 parent plants was highest (1.827 g), Seed yield per inflorescence (Table 1) indicated that 4 parent plants was lower than the others and parent plants 2, 8, 16 and 32 were very similar in this item. Measurement of inflorescence number (Table 1) revealed that 4 parent plants produced more inflorescences than the other parents did.

Seedlings from different parent plants: The seed taken from different parent plants, which was based on 2, 4, 8, 16, and 32 plant seeds were examined in this experiment. An experiment was set up to study 5 treatments in 26 replicates in large boxes measuring 240 x 110 cm filled with soil based on 30 kg Vitax "Q4" C5.3. 7.5.10.0 NPK) + 4.5 kg lime in 2,000 kilos soil compost. Two seeds of each treatment were sown in each location (5 locations in each row). Seedlings were thinned seven days after sowing one plant per location and 5 plants were left per replicate. Empty locations were filled with the same treatment of other replicates Coleoptile numbers were recorded ten days after sowing and dry weight was measured 30 days after sowing; each plant was cut at soil level and dried at 80°C for 24 h and weighed.

The analysis of variance of seedling dry weights of different parent numbers is presented in Table 4. Results showed that there were significant differences between parent's plants. This indicated that only parent number 8 was significantly lower than the others (Table 5).

Table 4: Seedling dry matter yield and coleoptile's numbers from different parent plants

Item	Numbers of parent plants					Mean	LSDP=0.05
	2	4	8	16	32		
Dry matter yield g plant ⁻¹)	119.88	114.55	109.95	116.25	115.03	115.13	6.0
Coleoptile's num plant ⁻¹	1.19	4.81	3.73	4.23	3.54	3.5	1.5

Table 5: Variance analysis of dry matter yield from different parent plants

Item	df	MS
Total	649	
Reps.	25	15780.29***
Parents	4	1657.61*
Error	620	616.40

Table 6: Variance analysis of coleoptile's number of different parent plants

Item	df	MS
Total	129	
Reps.	25	2.42
Parents	4	49.56***
Error	100	1.48

Table 7: Correlation from different parent plants

	DM	N (inf.)	SY	SY (inf.)	CN
Dry matter yield	-				
Num. of inflorescences	-0.348	-			
Seed yield	-0.701	0.697	-		
Seed yield of inflorescences	-0.302	-0.566	0.190	-	
Coleoptile's number	-0.614	0.887*	0.917*	-0.143	-

A comparison of coleoptile number indicated that there were highly significant differences ($P < 0.001$) between parent plants (Table 6). Coleoptile's number of 2 parent plants (1.19) was lower than the other parents. Appearance of coleoptile's tiller can be extremely important in determining total tiller production since its progeny comprise more than one-half the potential tillers on a plant. By producing more coleoptile's tiller, the low leaf elongation population established a higher basal number of tillers per plant very early in development (Skinner and Nelson, 1994).

It was apparent from the data given in Table 1 that lower seed yields were obtained from parent plants 2 and 32, and parent plants 4 had a higher number of inflorescence, but lower seed yield per inflorescence. There is negative correlation between number of inflorescences with dry weight ($r = -0.348$), and seed yield of inflorescences ($r = -0.566$) but positive correlation with seed yield ($r = 0.698$) (Table 7). The analysis of their seed germination (after 5 months of storing in laboratory conditions) indicated that there were significant differences between parental groups ($P < 0.001$) and also the parent x day interactions were highly significant. Parent plants 2 had a lower germination (62 %) and parent plants 16 a higher germination (95%). Subsequent seedling studies revealed that parent plants 8 had a significantly lower seedling dry matter yield than the others. In comparing coleoptile's number parent group 4 had higher (4.81) and parent group 2 lower (1.19)

numbers than the others (Table 4). Coleoptile's numbers had significant correlation with seed yield ($r = 0.917^*$), and number of inflorescences ($r = 0.887^*$) but negative with dry matter yields ($r = -0.614$) Table. 7.

There are several generalized concepts of physiological seed quality. The standard germination test was designed to estimate the potential planting value of seed. In practice, however, the standard germination test employs optimum conditions, which are seldom realized in the field. The standard germination test requires the development of a normal seedling in order for the seed to be counted as having germinated (Bean *et al.*, 1984; McDonald *et al.*, 1996).

There are a number of studies related to this subject (Barton 1953; Thomas 1966; Bean 1973, 1980; Griffiths *et al.*, 1973; Roberts 1975; Williams 1979; Skinner and Nelson 1994; Moore and Moser, 1995). Breese and Tyler (1981) reported that the minimum number of plants that should be sampled to form the basis of each population is critical. They pointed out that taking 25 plants of each family, as the minimum number is sufficient to maintain genetic integrity. Roelofsens (1981) noted that at regeneration the number of plants and the pollination system used should be recorded, so that the degree of maintenance of the genetic variation of a population can be established. The effect population size of 30-50 plants leads per generation to a loss of heterozygosity of 1-2 % (De Pace *et al.*, 1982). Studies by Elgersma and Snizko (1988) showed the cytology of seed development related to positions in perennial ryegrasses. Allard (1960) reported that increasing the number of lines would improve the yield of the synthetic varieties as long as the increase can be made without undue sacrifice in high combining ability. Breese and Lewis (1959) noticed that in varieties based on 2 plants and 3 plants, dry matter yields were slightly higher than the others, but it was not significantly different to the control. They also pointed out that in their earlier experiments the most efficient number of plants for a synthetic variety was four.

The results from the present experiment, although there are a limited number of observations, suggest that number of parental plants had no effect of marked significance on seedling growth.

References

- Allard, R.W., 1960. Principles of Plant Breeding. John Willey and Sons, Inc. U.S.A.
- Barton, L.V., 1953. Seed storage and viability. Contr. Boyce Thomson Inst., 17: 87-103.
- Bean, E.W., 1973. Seed quality, its variation, control, and importance in breeding and varietal assessment. In Welsh Plant Breeding Station (W.P.B.S.) Report 1972 pp: 194-208.

- Bean, E.W., 1980. Factors affecting the quality of herbage seeds. In *Seed Production*. pp: 593-604. Ed. D.D. Hebblethwaite Butterworths - London, Boston.
- Bean, E.W., S. Sengul and B.F. Tyler, 1984. The germination of grass seeds after storage of different temperatures in Al foil and manila paper packet. *Ann. Appl. Biol.*, 105: 99-405.
- Breese, E. L. and J. Lewis, 1959. The effect of varying the numbers of parent plants on the behavior of synthetic varieties. W.P.B.S. Report, pp: 21-25.
- Breese, E.L. and B.F. Tyler, 1981. Seed regeneration in cross-pollinated species. pp. 45-67. *Proc. C.E.C. Eucarpia Seminar Myborg-Denmark*. Ed. E.Porceddu and G.Jenkins, A.A. Balkema - Rotterdam.
- De Pace, C., L.M. Monti, P. Perrino, E. Porceddu, P.L. Spagnole'iti Zeuli and G.T. Scarascia Mugnozza, 1982. Theoretical aspects and practical implications of cross-pollination on seed regeneration of field crop genetic resources. *Proceedings of the CEEucarpia Seminar, July 15-17, 1981, Nyborg, Denmark*, pp: 211-251.
- Elgersma, A. and R. Snieszko, 1988. Cytology of seed development related to floret position in perennial ryegrasses, (*Lolium perenne* L.). *Euphytica.*, pp: 59-68.
- Griffiths, D.J., H.M. Roberts and J. Lewis, 1973. The seed yield potential of grasses. W.P.B.S. Report, pp: 117-123.
- Hayward, M.D. and E.W. Bean, 1984. Genetic characterization and theory of seed regeneration. N.R.B.C.R. Welsh Plant Breeding Station, Aberystwyth. UK.
- Hill, Jr. R.R. and H. Elgin, 1981. Effect of number of parents on performance of alfalfa synthetic. *Crop Sci.*, 21: 298-300.
- Kidwell, K.K., M. Hartweck, B.S. Yandell, P.M. Crump, J.E. Brummer, J. Moutray and T.C. Osborn, 1999. Forage yield of alfalfa populations derived from parents selected on the basis of molecular marker diversity. *Crop Sci.*, 39: 223-227.
- McDonald. Jr. M.B., L.O. Copeland, A.D. Knap and D.F. Grabe, 1996. Seed development, germination and quality. American Society of Agronomy Madison W153711, USA, Cool Season Forage Grasses. *Agronomy Monograph*, 34: 15-70.
- Moore, K.J. and L.E Moser, 1995. Quantifying developmental morphology of perennial grasses. *Crop Sci.*, 35: 37-43.
- Roberts, E.H., 1975. Problem of long term storage of seed and pollen for genetic resources conservation. In *Crop Genetic Resources for Today and Tomorrow*. pp.269-96. Ed. D.H.Franke, and J.G.Hawkes. Cambridge Univ. Press.
- Roelofsen, H., 1981. Genetic conservation by regeneration. *Proceedings CEC Eucarpia Seminar, July 15-17, Nyborg, Denmark*, pp: 151-164.
- Skinner, R.H. and C.J. Nelson, 1994. Role of leaf appearance rate and the coleoptiles tiller in regulating tiller production. *Crop Sci.*, 34: 71-75.
- Thomas, R.I., 1966. The influence of seed weight on seedling vigor in *Lolium perenne*, *Ann. Bot.*, 30: 111-21.
- Tyler, B.F., 1984. Genetic resources characterization of grasses. N.R.B.C.R. Welsh Plant Breeding Station, Aberystwyth. U.K.
- Williams, J.T., 1979. Seed stores for crop genetic conservation. I.B.P.G.R. Rome.