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Determination of Some Agricultural and Cytological Characters of Natural Cocksfoot Plants (*Dactylis glomerata* ssp. *glomerata* L.)

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Abstract: This 2 year study was conducted with the intend of determining some agricultural and cytological characters of native cocksfoot plants, (*Dactylis glomerata* ssp. *glomerata*) collected from several places in Ondokuz Mayıs University, Kurupelit Campus Samsun-Turkey in 2002-2003 years. A large variation was noted on examined characters in both 2 years. This variation shows that a selection programme on agronomically important characters of cocksfoot can be successful. Average number of fertile tillers, panicle length, number of spikelets in panicle and thousand seed weight of naturally growing cocksfoot plants were determined as 10.3-10.0, 13.0-10.8 cm, 143.8-133.3, 0.78-0.86 g in 2002 and 2003, respectively. Average seed yield per plant was 1.48 g in 2002 and 1.22 g in 2003. Average germination vigour of collected seeds were between 65.9-51.7%. All plants were tetraploid (2n = 28) according to result of somatic chromosome counts and aneuploidy and Chromosome B were not observed.

Key words: *Dactylis glomerata*, agricultural characters, seed yield, cytology

INTRODUCTION

It is possible to use present cultivars and native and wild species as an introduction material to determine the convenient forage crops species and cultivars for Turkey's regions.

Turkey is the home of many kinds of plants and has a huge potential concerning wild forage species population. Furthermore, using native vegetation has more advantageous than using introduction material for breeding studies because these plants have been well adapted to the ecological conditions of the region (Hatipoglu *et al*., 1992).

Suitable selection programme is essential for utilizing the native plant species as forage crops or for establishing artificial pastures. Native plants can be carried for cultivation by selection. They can be used for crossing to transfer desirable characters to any cultivar as well (Tosun *et al*., 1999). However, it takes long time to conduct breeding studies due to complex cytology of grass forage species, lack of knowledge on the species and complex growing systems. The cytology of the native plant species is highly important for breeding studies. Hatipoglu *et al*. (1994), also asserted that chromosome number, genome degree, meiotic characters and resporduction biology might directly affect the breeding programmes.

After the declaration of diploid and tetraploid cocksfoot forms in 1920, which commonly exist in natural vegetation, the origins of many tetraploid forms were determined owing to cyto-genetic studies. However, there is no sufficient study on cocksfoot populations in native vegetation in Turkey.

Canode *et al*. (1963), conducted a research on seed dormancy of 5 different cocksfoot cultivars. Germination test results were 91.3, 90.7, 81.3, 77.3 and 59.3% for the 5 different cocksfoot seeds, which had been stored for 6 months; and 93.2, 90.4, 82.2, 80.2 and 64.9% for the seeds stored for 8 months.

Lumaret *et al*. (1989), also reported 3 ploidy level of cocksfoot plants (2n = 14, 28, 42), while the tetraploids seemed to be more common ploids.

In a research on cocksfoot population collected from Cukurova University Campus area (Turkey), tetraploid cocksfoot forms having 2n = 48 chromosomes were more common and 40 cocksfoot plants had 2n = 29 chromosomes (Hatipoglu *et al*., 1992). In another research conducted in Erzurum province of Turkey, the chromosome number of native cocksfoot were counted and all had 2n = 28 chromosomes (tetraploid) (Tosun *et al*., 1999). Vilhar *et al*. (2002) studied a cytological experiment on four different native cocksfoot populations growing in different altitudes and concerning chromosome numbers, they claimed that all collected

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cocksfoot populations were in harmony with tetraploid *Dactylis glomerata* ssp. *glomerata* (2n = 28).

In this study, some generative characters, seed yield, thousand seed weight, germination vigour and somatic chromosome number of cocksfoot plants collected from 7 different locations were investigated of Ondokuz Mayıs University Kurupelit Campus area. Also, it is hoped that selected better cultivars from this study can be used in later breeding studies.

MATERIALS AND METHODS

Soil characters: Based on the soil analysis, salt ratio was rather low and the pH values indicating that the soil samples varied from slightly acidic to neuter character. The soil samples had rich Potassium contents; while its Phosphor contents were very low in location number 4, low in the location number 5, 6 and 3, medium in location number 1 and 2 and high in the location number 7. Meanwhile the organic matter contents were low in location 2 and 5, medium in location 1 and high in the other locations. In addition, location number 1, 3 and 7 had clay soils; and location number 2, 4, 5 and 6 had clay loam soils. Considering the results, it can be assumed that cocksfoot is not selective plant in terms of soil requirements.

Climate characters: Samsun province has generally warm summer and cool winter. The total precipitation in Samsun province during the growing period of cocksfoot plant was 381.4 mm in the long term, 395.5 mm in 2002 and 323 mm in 2003. The fastest plant growth period for cocksfoot was in May with total precipitations was 10.9 mm in May 2002 and 54.7 mm in May 2003. Long term mean temperature of Samsun province was 14.33°C between January and August. The mean temperature in 2002 (14.9°C), however, was higher than the long term mean temperature and the mean temperature in 2003 (14.2°C) was lower. Concerning the growing period of cocksfoot, the highest temperature in 2002 was 25.6°C July, but it was 24.1°C in August 2003. The long term mean relative moisture was 74.7%, it was 73% in 2002 and 73.6% in 2003 (Anonymous, 2003).

Material: Native cocksfoot plant material (*Dactylis glomerata* ssp. *glomerata* L.) was used in this study. Seed samples were collected from seven different locations having intensive plant populations between June-August 2002 and 2003. General characteristic information of the locations is shown in the Table 1.

Methods: Plant samples were observed between April and August and panicle and seed characters were noted referencing (Anonymous, 2001). Root tip crushing method was used for somatic chromosome study (Hatipoglu *et al*., 1992; Elci, 1994).

The data obtained from this study was analysed according to randomized plot design (Acikgöz, 1993) using ANOVA and the Duncan Multiple Test to establish significant differences in MSTAT-C packet programme. Moreover, measurements on cocksfoot plants were compared using standard error and confidence limits at 0.05 probability level (Tosun, 1998).

RESULTS AND DISCUSSION

The number of fertile tiller, panicle axis length, spikelet number per panicle, 1000 seed weight, seed yield per plant and germination vigour of cocksfoot samples were examined during the study period of 2002 and 2003. Variation limits, confidence limits and coefficients of variation are presented in Table 2 and means of inspected values are shown in Table 3.

Fertile tiller number: Concerning the number of fertile tiller, the coefficient of variation was 50 and 41% in 2002 and 2003, respectively (Table 2). The difference in the number of fertile tiller among the locations was highly significant in 2002; however it was not significant in 2003 (Table 3). The highest average number of fertile tiller was found in the location 4 and 2, which 15.6 and 13.7 in 2002. Even though there was not statistical differences in the number of fertile tiller among the locations in 2003, the highest average number of fertile tiller was obtained from the location 5 (11.8). The findings appear to be lower than that of Tükel ve Hatipoğlu (1994)'s study. Tosun (1992) reported that the tiller number of cocksfoot plant depends

Table 1: General information of the locations in OMU Kurupelit Campus from where cocksfoot samples collected

Location No.	Soil depth (cm)	Altitude (m)	General characters of locations
1	90-120	24	About 10% slope, north-east, orchard saplings
2	0-30	147	About 20-25% slopes, shallow soil depth, slightly pebbly, short bushy vegetation, northwest
3	0-30	180	West, Oak trees, pasture in forest
4	30-60	188	5% slope, rarely tree, north east
5	0-30	190	Cultivated about 26 years ago and abandoned, east
6	30-60	191	Shallow soil depth, slightly pebbly, southwest, on the side of road
7	30-60	192	Open area among the oak trees, north-western

Kara *et al.* (1993)

Table 2: Variation limits, confidence limits and coefficients of variation of panicle and seed characters of cocksfoot plants in OMU Kurupelit Campus in 2002 and 2003

Characters	n	Year	Variation limits	Confidence limits	CV (%)
Fertile tiller number	70	2002	3.00-28.0	10.31±1.22	50
	70	2003	3.00-25.0	10.00±0.99	41
Panicle axis length (cm)	70	2002	5.10-26.6	13.00±0.95	30
	70	2003	3.40-25.5	10.75±0.88	34
Spikelet number per panicle	70	2002	74.00-258.0	143.80±10.34	30
	70	2003	63.00-241.0	133.31±10.74	33
Thousand seed weight (g)	70	2002	0.41-1.20	0.78±0.06	32
	70	2003	0.30-1.50	0.71±0.07	38
Seed yield (g plant^{-1})	70	2002	0.55-4.92	1.46±0.23	65
	70	2003	0.26-3.88	1.21±0.17	59
Germination vigour (%)	70	2002	12.80-95.8	65.89±6.36	40
	70	2003	18.80-87.4	51.30±4.22	34

Table 3: Means of panicle and seed characters of cocksfoot plants in OMU Kurupelit Campus in 2002 and 2003

	Characters											
	Fertile tiller No.		Panicle axis length (cm)		Spikelet No. per panicle		Thousand seed weight (g)		Seed yield per plant (g plant^{-1})		Germination vigour (%)	
Location No.	2002**	2003	2002	2003**	2002	2003**	2002**	2003**	2002**	2003*	2002**	2003*
1	10.2bc	8.8	13.3	14.6a	116.3	144.3ab	0.96a	1.10a	2.65a	1.88a	91.3a	47.9bc
2	13.7ab	10.2	14.3	10.1ab	160.3	175.4a	0.45d	0.51c	1.24b	1.07b	36.6c	50.2bc
3	6.8c	11.2	12.0	11.1ab	141.8	110.4bc	0.55cd	0.49c	1.05b	1.22b	40.9c	69.2a
4	15.6a	10.7	13.3	10.2ab	158.7	157.3ab	1.02a	0.57c	1.59b	0.79b	44.9c	52.4bc
5	6.3c	11.8	13.6	9.4b	137.6	133.9abc	1.05a	0.90b	0.89b	1.27ab	60.1b	41.8c
6	9.6bc	6.9	11.6	8.5b	161.2	94.3c	0.65c	0.94ab	1.03b	1.11b	93.9a	45.1bc
7	10.0bc	10.4	12.6	11.5ab	130.9	117.6bc	0.81b	0.48c	1.40b	1.23b	93.9a	55.4b
Means	10.3	10.0	13.0	10.8	143.8	133.3	0.78	0.86	1.48	1.22	65.9	51.7

Values in the same column followed by the same letters are not significantly different at the *0.05 and ** 0.01 level

on environmental factors, plant age and plant growth. Furthermore, Davies and Thomas (1983) also reported that tillering capacity depends on environment temperature, light time and quantity of soil nutrients. Nevertheless, genetical variation of cocksfoot and different environmental conditions from where the samples were collected might cause the different tiller number in this study.

Panicle axis length: Concerning panicle axis length of all cocksfoot samples, the coefficients of variation were 30 and 34% in 2002 and 2003, respectively (Table 2). These values are lower than the data reported by Tukel and Hatipoglu (1994). The differences among the locations were not statistically significant in 2002, but it was highly significant in 2003 (Table 3). However the highest panicle axis length was found in location 2 (14.3 cm) and the shortest panicle axis length was found in location 6 (11.6 cm) in 2002. The cocksfoot samples obtained from location 1, 2, 3, 4 and 7 appeared to be in the same group in terms of the panicle axis length in 2003. Meanwhile, the average panicle axis length was noted 13.0 cm in 2002 and 10.8 cm in 2003. The panicle axis lengths in both years were higher than the panicle axis lengths reported by Tosun (1992), Tükel and Hatipoglu (1994) and Mika *et al.* (2002).

Spikelet number per panicle: The coefficients of variation for the number of spikelet per panicle of the cocksfoot samples were 30% in 2002 and 33% in 2003 (Table 2). These values are slightly lower than the data reported by Tükel and Hatipoğlu (1994). Differences among the locations concerning spikelet number per panicle were statistically insignificant in 2002, but it was highly significant in 2003 (Table 3).

In 2002, the highest value was detected as 161.2 spikelet per panicle, which was obtained from the location numbered 6; while the samples obtained from location 2 had 160.3 spikelet per panicle. In 2003, cocksfoot samples collected from location 2, 4, 1 and 5 appeared to be in the same group concerning the number of spikelet per panicle. These values are lower than the data reported by Tükel and Hatipoğlu (1994), but parallel to Tosun (1992)'s findings.

1000 seed weight: The coefficients of variation for the 1000 seed weight of all cocksfoot plant samples were 32% in 2002 and 38% in 2003 (Table 2). Table 3 also shows statistically significant differences among the locations concerning the 1000 seed weight in both years. The highest 1000 seed weight was determined on the plant sampled from location 5, 4 and 1 (1.05, 1.02 and 0.96 g) in 2002 and location 1 and 6 (1.10 and 0.94 g) in 2003. These values were parallel to data reported by Tosun (1992), Tukel and Hatipoglu (1994), Rumball *et al.* (2001) and Manga *et al.* (2002); however they were higher than the values by Mika *et al.* (2002).

Seed yield per plant: The coefficients of variation calculated on totally 70 cocksfoot plants in all locations were 65 and 59% in 2002 and 2003, respectively (Table 2). These values were higher than the values reported by Tükel and Hatipoglu (1994). Concerning the seed yield per plant, the differences among the locations were highly significant in 2002, but it was not significant in 2003. The highest seed yield per plant was obtained from the location 1 (2.65 g) in 2002. Other locations appeared to be in the same group regarding seed yield per plant. In 2003, location 1 and 2 had higher seed yield per plant (1.88 and 1.27, respectively). These data are far lower than the findings from other studies. For example, Lucchin *et al.* (1990) determined the seed yield per plant as 21.2 g. Tükel and Hatipoglu (1994) reported seed yield per plant between 19.88 and 22.70 g; while Tosun (1996) noted the seed yield per plant between 18.19-27.89 g for cocksfoot. However, the panicle axis length, number of spikelet per panicle and thousand seed weight measurements were similar to the findings reported by other researchers, but the total number of tiller and the number of fertile tiller were rather lower than the findings from other researchers. Considering this situation, low number of fertile tiller and low seed set might cause the low seed yield per plant. Coastal area of Samsun province, hence, may not be a suitable place for seed production due to cloudy and rainy climate in spring months when flowering and pollination occur in cocksfoot. As a matter of fact, Manga (1991) and Sehirali (2002) reported that seed yield, seed-set ratio and seed quality could be low in the coastal areas having unsuitable with environmental conditions.

Germination vigour: Regarding the germination vigour of cocksfoot plants, the coefficients of variation were 40 and 34% in 2002 and 2003, respectively (Table 2). Table 3 shows that variation in the germination vigour among the locations was highly significant in 2002 and significant in 2003. The highest value of germination vigour was determined in the location 6, 7 and 1 (93.9, 93.9 and 91.3%, respectively) in 2002 and in location 3 (69.2%) in 2003. As the coefficient of variation decreased with increasing homogeneity, germination vigour increased. The value was higher than the values given by Tosun (1992), however it was similar to the values reported by Canode *et al.* (1963).

Counting of somatic chromosome: Root tip samples were obtained from the seedlings which were germinated to count the chromosomes. Mitotic chromosome numbers were determined on totally 70 samples representing 7 different groups. It was found out all inspected plants were tetraploid (2n = 28) and there was no aneuploid plant. Concerning these data, cocksfoot form having 2n = 28 chromosome appeared to be common in the research area. Results obtained from the study was in harmony with the findings reported by Amirouche (1990), Tosun (1994), Tükel and Hatipoglu (1992) and Vilhar *et al.* (2002). Cocksfoot had 3 ploidy level which are 2n = 14, 28 and 42. Tetraploids were more common and widespread than the others (Lumaret *et al.*, 1989; Tosun, 1992). Meanwhile, any aneuploid plant not encountered as aneuploid plants were in difficulty for seed-set progress due to overgrazing (Turhan, 1996).

CONCLUSIONS

The naturally grown orchardgrass plants (*Dactylis glomerata* ssp. *glomerata* L.) showed remarkable variation in some investigated agronomic and cytologic characters. This fact is important in case of genetic diversity and shows that selection procedures regarding seed yield should be successful.

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