BOOK OF PROCEEDINGS

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PREFACE

Dear Colleagues,

In your hands are the *Proceedings* of the 7th International Scientific Agricultural Symposium "AGROSYM 2016", which I hope you will find useful in your research, education and professional activities and endeavors.

AGROSYM 2016 themes cover all branches of agriculture and are divided into seven sessions: 1) Plant production, 2) Plant protection and food safety, 3) Organic agriculture, 4) Environmental protection and natural resources management, 5) Animal husbandry, 6) Rural development and agro-economy, and 7) Forestry and agroforestry.

Keynote papers dealt with organic agriculture from different perspectives as well as international cooperation in agricultural and rural development, climate change and forestry. Organic farming is a holistic production management system of agricultural, food and other products, combining good agricultural practices, a high degree of biodiversity, conservation of natural resources, and application of high standards of animal welfare.

Food production, food security and production of raw materials for other industries determine multiple environmental, economic and social roles of agriculture (including crop production, animal husbandry, forestry and fisheries) in all countries, both developed and developing ones, as well as its multi-functionality; including its contribution to rural development. This is clearly highlighted in the numerous contributions included in these *Proceedings* alongside the challenges that agriculture sector is facing and the negative impacts of industrial agriculture on the environment.

I do believe that the research results reported here will be significant in the dissemination of knowledge to the wider audience about the importance of agriculture as a strategic sector in many countries.

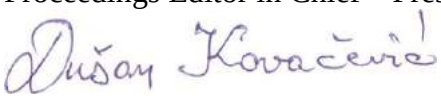
AGROSYM 2016 made an important contribution to the agriculture theory, knowledge and practice in different areas. During the four-day symposium on October 6-9, 2016, over 1100 contributions were presented (either as oral or poster presentations) to more than 1000 participants representing 78 countries.

The *Proceedings* comprise an edited selection of the papers submitted to the symposium. Each paper included in the *Proceedings* was positively reviewed by referees.

AGROSYM 2016 was made possible through the commitment and contributions of a wide range of partners and sponsors. Many thanks to all authors, reviewers, session moderators and colleagues for their help in editing these *Proceedings*. Special thanks go to all co-organizers for their unselfish collaboration and comprehensive support.

East Sarajevo, 05 October 2016

Prof. Dušan Kovačević, Faculty of Agriculture, University of Belgrade
Proceedings Editor in Chief – President of the Scientific committee of AGROSYM 2016



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Introduction to SWG GIZ project 2970

1. PLANT PRODUCTION

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VARIATION IN *Digitalis ferrugineae* L. MULTIPLICATED WITH SEED UNDER THE PROVINCE RIZE CONDITIONS IN TURKEY

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Abstract

This study was carried out to examine the variation of some traits of *Digitalis ferrugineae* L. at Pazar/Rize/Turkey conditions. The experiment was conducted in 2014/2015 in the field trials belonging to the Faculty of Agriculture and Natural Science, Recep Tayyip Erdoğan University. *Digitalis ferrugineae* L. seeds were sown firstly into viols in greenhouse. The seedlings were planted into the field at 5-6 leave stage in 2014. All measurements were done using selected twenty plants in 2015. There were great variation between the plants investigated in the study. The change interval was 68,5-148,5 cm for plant height; 28,0-95,5 cm for spike length; 3,92-10,08 mm for spike diameter just below the first capsule; 5,92-13,5 mm for root collar diameter; 0-14 for number of branches per plant; 0,3-9,4 g for seed yield per plant and 0,31-0,69 g for 1000 seeds weight. The positive corelations were found significant ($P<0.05$) between seed yield per plant and three characters which were spike length (r=0,4890), spike diameter (r=0,5181) and root collar diameter (r=0,5799). In addition, relationship between plant height and spike length was found significant. As a result the plants of *Digitalis ferrugineae* L. multiplicated with seed displayed great variation and could be advantageous for further breeding studies.

Keywords: *Digitalis ferrugineae, spike, seed, variation*

Introduction

Digitalis ferruginea (=*D. aurea* Lindley) is a widespread member of the eight *Digitalis* species from the family *Plantaginaceae* (=*Scrophulariaceae*) in Turkey (Davis, 1978). The genus *Digitalis* composed of more than 20 species, and is commonly known as the "foxglove". The name *Digitalis* means "finger of a glove" as Latin which refers to the shape of the flowers (Clemente et al., 2011). Members of the genus *Digitalis* L. are medicinally and economically important plants as they comprise the main source of cardiac glycosides, which are therapeutically used for the healing of congestive heart failure and regulate heart rhythm (Baytop, 1999).

It is known that only two species have been grown as a source of glycosides for pharmaceutical industry, especially *Digitalis lanata* Ehrh. and *Digitalis purpurea* L. (Bown 1995). These species successfully grown at farms with excellent biomass and seed production capacity in recent years (Negi et al., 2012). Moreover it is known that *D. lanata* were cultivated in 230 hectares of Netherlands by 1984s (Mastenbroek, 1985).

Apart from cardiotonic therapeutic efficacy, it is also used as diureticand in the reduction of oedema due to its ability to improve cardiovascular circulation (Perez-Bermudez et al., 1990). In addition, preliminary studies have revealed that digoxin and digitoxin obtained from *Digitalis* species are also effective agents in cancer, in particular for prostate and breast cancer treatments (Yeh et al., 2001; Lopez-Lazaro, 2007; Newman et al., 2008).

In fact, the Digitalis species which also have ornamental value have been the subject of studies for the improvement the cultivars with high content in cardiotonic glycosides to be used for medicinal purposes (Ardelean et al., 2006).

All parts of *D. ferruginea* are poisonous (Chiej, 1984) and this species is known as "rusty foxglove" all over the world and "pas renkli yüksük otu" in Turkey (Ozturk et al., 2008) It is a biannual or perannual plant. As with other *Digitalis* species, *D. ferruginea* also comprises cardiac glycosides and is the most abundant of *Digitalis* members in Turkey flora.

There is no research on agricultural traits of *D. ferruginea* before. Cultivation with sowing of seeds in medicinal plants in particular can lead to a new variation in the plants which are available to cross pollination. That variation is great in terms of breeders is a great opportunity to improve new cultivars. In this study, the plants of *D. ferrugineae* L. multiplicated by seed were compared regarding the stem, spike and seed traits.

Materials and methods

This research was conducted in 2014/2015 in the field trials belonging to the Faculty of Agriculture and Natural Science in Recep Tayyip Erdoğan University in Pazar district of Rize Province in the Black Sea Region of Turkey. Expermental field is located at 41°10.668′ N latitude, 40°54.018′E longitude with an average altitude of 65 m above mean sea level.

The district Pazar has a climate displaying warm summer, moderate winter and rainfall in every season. According to the records of the Turkish State Meteorological Service, the District's Long-term average precipitation is 1978.1 mm; long-term average of growing season (April-October) is 1100.1 mm (TSMS, 2013).

The seeds of *Digitalis ferrugineae* L. populations (foxglove) from flora were firstly sown into viols in greenhouse on 21th of february in 2014. When the seedlings reached the stage with 5-6 leaves, they were planted into the field. The distances between the plants were 40x30 cm. Twenty plants were selected and some traits of these plants were determined in the next year (2015) of the experiment.

In this study, examined agricultural traits of foxglove were plant height, spike length, spike diameter (just below the first capsule), root collar diameter, seed yield per plant and 1000 seeds weight.

Results and discussion

Stem characteristics

Plant height is one of the most important agricultural traits to enable harvest in almost all crops. Moreover, plant height may also influence to prevent yield loss at harvest. The plant with high height generally are under risk to yield loss because of laying. In addition, there are possible correlations in between the plant height with other traits of plants.

In the present study, plant height varried from 68,5 cm to 148,5 cm (Table 1). Plant height was positively correlated with spike length and **s**pike diameter. The highest value (10,08 mm) regarding to spike diameter were obtained from the plant number 2 which plant heigth was 100 cm. Similarly, the plant number 2 had also the highest value regarding to root collar diameter.

Positive correlation was found between root collar diameter and spike diameter. These two characters assure a stronger stem structure in plant against adverse environmental conditions such as heavy rainfall and wind. In this study, firstly, the plant number 2 with number 15 had more advantageous of stem structure than others. On the other hand, an unusual branching on the bottom part of the stem was determined in only a plant.

The plant number 15 had been the only plant showing branching on the bottom of the stem. The stem traits of twenty plants examined showed a wide variation and it is clear that among these plants regarding to stem stiffness, in particular number 2 had a strong stem.

Table 1**.** The values belonging characters examined in the study

Gntyp	Plant height (cm)	Spike length (cm)	Spike diameter (mm)	Root collar diameter (mm)	Branching on spike (unit)	Seed yield per plant (g/bitki)	1000 seeds weight (g)	Seed color
1	104,5	42,5	5,81	8,26	0	2,59	0,644	AK
2	100	93,7	10,08	13,5	10	6,06	0,542	K
3	126	66,5	7,15	10,58	0	9,42	0,436	K
4	99,8	53,6	5,97	8,62	0	3,3	0,354	K
5	87,4	41,5	5,04	6,25	0	1,42	0,370	K
6	131	63	6,22	7,36	0	4,47	0,442	AK
7	119	58	6,35	8,62	0	5,08	0,360	K
8	83	28	3,92	7,26	0	0,27	0,388	KK
9	116,5	79,5	8,12	8,87	12	4,06	0,374	K
10	110,5	48	5,47	7,68	0	1,97	0,457	AK
11	94	37	4,37	6,07	0	1,7	0,509	AK
12	130	57	5,48	6,64	0	0,77	0,432	AK
13	95,3	44,5	7,03	9,63	0	2,1	0,308	K
14	144	95,5	7,37	8,49	6	4,24	0,469	K
15	148,5	93	9,15	12,22	14	4,09	0,485	K
16	100	35	5,34	8,57	0	3,27	0,448	AK
17	110	55,3	4,68	6,26	0	2,03	0,435	AK
18	68,5	44,5	5,36	5,92	0	0,45	0,436	KK
19	119,5	62,6	6,75	8,38	0	2,6	0,686	K
20	114,7	52,5	5,62	7,23	0	6,2	0,491	K

Gntyp: plant, B: brown, DB: dark brown, LB: light brown

Spike characteristics

Spike length is one of the important characteristics that affect the seed yield. The positive corelations were found significant ($P<0.05$) between spike length and four characters which were plant height (r=0,6980), spike diameter (r=0,8698), root collar diameter (r= 0,6648) and seed yield per plant (r= 0,4890) (Table-2). Among the plants examined in the study, spike length showed a large variation between 28,0 cm and 95.5 cm. The highest spike length was obtained from the plant number 14 and followed it plant number 2 with 93.7 cm, plant number 15 with 93.0, plant number 9 with 79.5 cm, plant number 3 with 66.5 cm and others respectively.

A total of four plants occurred branching in their spikes. Numbers of branch ranged from 0 to 14 in the plants. The highest values regarding to spike lengths were obtained from same four plants. In addition, these four plants took place within the first eight for seed yield per plant and seed yield per plant ranged from 0,27 g to 9.42 g for all the plants. This research showed that the seed yield per plant correlated with three characters, spike length, spike diameter and root collar diameter. In terms of seed yield per plant, the highest values as 9.42 g, 6.20 g and 6.06 g obtained from plants number 3, 20 and 2 respectively. The only negative relationship which was not statistically significant occured between seed yield per plant and 1000 seeds weight. Although some plants (such as plant number 2) had higher both spike length and 1000 seeds weight, their seed yield per plant was lower. This decrease in the seed yield per plant could probably arise from differences in the number of capsules per spike and number of seeds per capsule.

Table 2. The relationships (corelations) between characters

	Characters	Plant height	Spike length	Spike diameter	Root collar diameter	Seed yield per plant	1000 seeds weight
1	Plant height	1,0000					
2	Spike length	0,6980*	1,0000				
3	Spike diameter	0,4772*	0,8698*	1,0000			
4	Root collar diameter	0,3596	0,6648*	0,8896*	1,0000		
5	Seed yield per plant	0,4141	0,4890*	0,5181*	0,5799*	1,0000	
6	1000 seeds weight	0,1855	0,1676	0,1501	0,1299	-0,0192	1,0000

*P<0.05 (the relationships between characters was determined acording to 5 % of significant level)

Seed characteristics

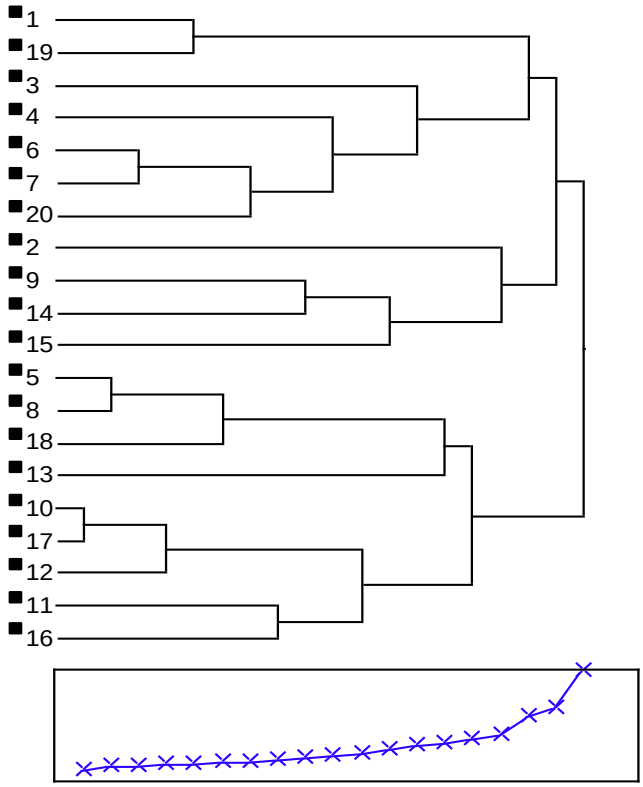
The plants forming leaf rosette in the first year comprised spike in the second year. After the planned measurements were carried out, the harvest was performed in complete dry period of the spikes. All the plants harvested on 10th of August in 2015 except the plants number 19 and 13 which harvested on 20th of August and 25th of August respectively.

Great differences were determined in the plants regarding to seed color, seed length, seed width and 1000 seeds weight. Seed colors were in eleven plants was brown, light brown in seven and dark brown in two. 1000 seeds weight in the examined plants ranged from 0.308 g to 0.686 g. The longest seeds obtained from the plant number 15 while the largest seeds observed in the plants number 1, 13 and 19. The highest 1000 seeds weight was determined from the plants with large seeds except number 13. A great part of the seeds of the late maturing plant number 13 were undersized and did not have the ability to germinate. This immature seeds caused to decrease 1000 seed weight of the plant number 13. On the other hand, in terms of germination ability, the strong seeds of the same plant were combined and measured for 1000 seeds weight. Its seeds were even larger than the plants number 1 and 19, and reached to 1 g regarding to 1000 seeds weight.

Twenty plants were compared with Cluster Analysis for total of 6 characters (from stem, spike and seed characteristics) to determine the relationships between each other. The dendrogram obtained from cluster analysis showed in Figure-1. It was seen that the plants number 1, 2, 3, 4, 6, 7, 9, 14, 15, 19 and 20 with other plants number 5, 8, 10, 11, 12, 13, 16, 17 and 18 constituted two distinct groups in the dendrogram. As seen in the cluster, the closer pairs of plants were number 10-17, 5-8, 6-7 and 10-12 respectively. Plants which the most distant to each other were between number 1 and 3 plants including number 3, 2 and 5 respectively.

Hierarchical Clustering
Method = Ward

Dendrogram



Clustering History

Number of Clusters	Distance	Leader	Joiner
19	0,693609801	10	17
18	0,882664341	5	8
17	0,914842371	6	7
16	0,969343677	10	12
15	1,040850674	1	19
14	1,105025642	5	18
13	1,168393730	6	20
12	1,209048865	11	16
11	1,386126056	9	14
10	1,447999580	4	6
9	1,606886780	10	11
8	1,888093794	9	15
7	2,021613691	3	4
6	2,225740375	5	13
5	2,419990550	5	10
4	2,720542402	2	9
3	3,778657137	1	3
2	4,252675163	1	2
1	6,403497157	1	5

Figure 1. The Dendrograms from total of six characters

Conclusion

The data obtained from this study are important for creating resources in future researches. A wide variation was determined in a limited number of plants in *Digitalis ferruginea* L. multiplicated with seed regarding to stem, spike and seed characteristics. In addition, it may be possible to obtain a wider variation by increasing the number of plants grown in present conditions. A great variation can create an advantage for breeders in terms of their studies and also provides ease of superior material selection.

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