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EVALUATION OF DIFFERENT OAT VARIETIES FOR YIELD AND YIELD RELATED TRAITS IN ALBANIAN CONDITIONS

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Abstract. The objective of this study was to evaluate different oat genotypes in order to compare grain yield and some important yield related traits during three consecutive years in the Central Region of Albania. The varieties were differed significantly ($P \leq 0.05$) in grain yield and yield traits. The varieties Torpan, Bendo, Goka produced significantly higher grain yield (5.35, 5.2 and 5.22 t/ha), respectively. High grain yield of Torpan and Bendo was associated with high yield traits. So biomass yield, panicle weight, grain/panicle, and 1000 grain weight of these varieties was 15.99, 3.6, 159.6, 23.8 and 15.95, 3.6, 143.5, 23.5 respectively. It is evident that the highest influence on the grain yield of both varieties was the result of high panicle weight. Meanwhile, high grain yield of Goka variety was the result of high1000 grain weight (25.1 g). Gele Van Timer and Argus varieties produced significantly higher biomass; the first because of the higher plant height (160.4 cm) and the second because of the higher tillers/m2 (474). As the average of three years the lowest grain yield (4.2 T/ha) was obtained from Gele Van Timer variety. Other varieties Flavia (4.34 t/ha) and USO-32 (4.49 t/ha) also were placed in the same group with Gele Van Timer variety. Often, high biomass yield is associated with high grain yield, but this is not confirmed in the case of these three varieties. This can be explained by the different way of dry matter partitioning.

Keywords: *biomass, grain yield, oat, varieties, yield traits.*

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1. Introduction

Oat (*Avena sativa* L.) is an important cereal crop and is commonly grown for food and feed. As compared to the other cereals, oat is considered to be more suitable for growing under marginal lands, including cool-wet regions and unfertile-arid lands (Buerstmayr *et al*., 2007). The livestock grain feed is still the primary use of oat crops, accounting for an average of around 74% of the world's total usage (Welch, 1995). It can be fed in any form like green forage or silage, covering the scarcity period of the year. Oats considered a food source of protein, carbohydrates, fibre, vitamins and mineral elements, and compounds with beneficial effects on human health. (Peterson et al 2005). High grain yield is the most desired characteristic of oat cultivars. Old traditional varieties of oat are suitable for our climatic conditions, but they do not respond to improving management practices This is the main factor of low production of oat. With the introduction of newly evolved high yielding oat varieties, is important to improve their yield production. Recently some new varieties of oat have been developed, which are having capacity to produce higher seed yield. The development of modern practices, optimization of natural resources and the selection of superior genotypes with desirable agronomic traits have increased yield of grain in recent decades. The total oat production has decreased continuously, while the demand for it, as a human food has increased due to nutritional benefits of whole grain and content of b - gluconate (Buerstmayr *et al.*, 2007). The attraction of farmers for seed production of forage crops, particularly oat can be made possible by introducing the varieties, which are having the potential of producing higher seed yield. The yield of grain oat as a result of genetic improvement is up to 0.8 percent per year, depending on the country and genotype (Holland 1997). Oat genetic gain is lower than in other cereal species such as wheat and barley, which is attributed to the presence of undesirable traits in germplasm of oats as high sensitivity to disease (Stuthman 1995).

Therefore, keeping all the above facts in view, the present study was undertaken with the objective to identify oat varieties with superior seed yield and related yield traits for livestock production.

2. Materials and methods

The experiment was conducted to compare the grain yield and yield related traits of 10 varieties of oat (*Avena sativa* L.) at the Agricultural Technology Transfer Centre, Fushe Kruje, Albania during the year 2015 to 2017. Experiment was laid out in randomized complete block design (RCBD) having four replications.

The oat was drill seeded 450 seeds m^{-2}. Each plot was 6m long and consisted of six rows spaced 0.20 m apart. In three years, all agro-technical operations were carried out at optimal terms according to the weather conditions during the vegetation period and depending on the plant development phases. Agronomic characters recorded were: plant height (PH), tillers/m^{-2}, dry matter yield (DMY), grain number panicle^{-1} (GNP),grain weight panicle^{-1} (GWP), 1000 grain weight (1000-GW), grain yield (GY), and harvest index (HI).

Data for these traits was obtained from inner 4 rows of each plot. Plant height was measured as cm from the base of the lowest culms of oat plant to tip of the furthest panicle on main stem

Numbers of tillers m^{-2} was recorded by counting the number of tillers of one-meter length in two central rows of each plot and then converted to tiller m^2. Dry matter yield (DMY) was calculated by multiplying fresh fodder yield and dry matter (%), panicle sub-samples were randomly harvested before grain yield harvest from these 4 rows, to determine grain number, 1000-grain weight and grain weight panicle^{-1}.

Grain yield (t/ha) was determined by weighed of grains obtained after the harvest of rest area in each plot. The Harvest index (HI) was calculated as the ratio between grain yield and DMY.

Statistical analysis: The data was statistically analysed according to Steel et al. for randomized complete block design and means among different treatment were composed using least significant differences (LSD) test (P 0.05).

3. Results and discussion

The data on yield and yield components are presented in Table 1 indicated significant differences among genotypes in all the characters.

3.1. Grain yield t/ha

As average of three years. the highest grain yield (5.35 t/ha) was obtained from Torpan variety Goka (5.22 T/ha). Bendo (5.2 T/ha) and Abed minor (5.16 T/ha) varieties were also higher than the others and those cultivars were placed in to the same group with Torpan variety. Varieties above mentioned, compared to the average yield of all the other varieties (4.57 T/ha) were provided higher GY at the rate 17.1%. 14.2%. 13.7% and 12.9% respectively. High grain yield of Torpan and Bendo was associated with high yield traits. So DMY, panicle weight, grain/panicle, and 1000 grain weight of these varieties was 159.9, 3.6, 159.6, 23.8 and 159.5, 3.6, 143.5, 23.5 respectively. As the average of three years. the lowest grain yield (4.2 T/ha) was obtained from Gele Van Timer variety. Other varieties Flavia (4.34 T/ha) and USO-32 (4.49 T/ha) also were placed in the same group with Gele Van Timer variety. The remaining varieties including local variety Këmishtaj occupy an intermediate place between the two groups. The differences in yield among the genotypes grown in the same environment were due to genetic influences. Similar results in agreement with our findings were reported by previous works Yilmaz and Dokuyucu, (1994); Dokuyucu et al. (1997) reported great importance of genetic structure on yield.

3.2. Plant height (cm)

Analysis of variance showed significant differences among genotypes for plant height. indicating appreciable amount of variability among the genotypes in the experiment. Differences in plant height among genotypes are expected due to genetic make-up of the varieties. Varieties Gele Van Timer and USO-32 were found to be the tallest variety with the average height of 160.4 cm and 154.2 cm respectively. On the other hand, variety Flavia was found to be the shortest with the height of 118.5 cm. (Table 1).

Table 1. Three years' values of grain yield and related yield traits

Nr	Varieties	Plant height (cm)	Tillers/m^2	Dry matter yield	Panicle weight	Grain/panicle	1000 grain weight	Grain yield	Harvest index
1	Gele Van Timer	160.4	409	16.31	3.0	135.9	21.56	4.20	25.7
2	Torpan	133.0	423	15.99	3.6	159.6	23.8	5.35	33.45
3	Bendo	135.2	407	15.95	3.6	143.5	23.5	5.20	32.6
4	Goka	140.5	413	15.00	2.9	136.7	25.1	5.22	34.8
5	Visto	1139.2	397	15.92	3.0	128.3	23.4	4.67	29.3
6	Abed minor	147.0	403	15.60	3.4	135.7	25.1	5.16	33.07
7	Argus	131.6	474	16.39	3.3	134.0	24.7	4.75	28.98
8	Këmishtaj	132.5	406	16.08	3.4	144.9	23.5	4.95	30.78
9	Flavia	118.5	450	15.96	2.7	93.7	29.8	4.34	27.19
10	USO-32	154.2	465	15.89	3.2	104.9	30.3	4.49	28.25
11	**LSD 0.05**	**8.7**	**20.8**	**0.12**	**0.2**	**6.8**	**0.7**	**0.27**	**0.8**

It is observed that in spite of being the tallest varieties Gele Van Timer and USO-32 didn't prove to be the high yielding. It may be due to its large LAI at the flowering stage which is characterized by high temperatures and lack of rain. But this variety could be suitable for optimal growth conditions. The significant effect of variety on plant height in present study is in agreement with previous findings (Kibite *et al.*, 2002b). Chohan et al (2004), Buerstmayr et al. (2007) indicated that average plant height of 120 oat genotypes of worldwide origin under different environment ranged from 80.4 cm to 140.4 cm. They also showed that the majority of the top yielding 50 varieties were in the range of 100-120 cm.

3.3. Number of tillers m^{-2}

The datashow that exist significant differences among the varieties for the number of tillers $m.^{-2}$Maximum numbers of tillersm^{-2} were recorded in Argus, USO-32 and Flavia varieties (474, 465 and 450 tillersm^{-2}) respectively. Number of tillers m^{-2} is an important yield contributing parameter. Generally, the number of tillers per $meter^{-2}$ is directly proportional to fresh fodder yield, but in our case it wasn't significant to grain yield. Indeed, the three varieties have low grain yield (4.75, 4.34 and 4.49 t/ha).All the other varieties had similar result regarding this parameter.

3.4. Number of grainpanicle^{-1} and panicle weight

Panicle weight in oat combines two of the three primary yield components spikelet per panicle and grain weight into a single trait that is easy to measure. The data of our study showed significant differences for number of grainpanicle^{-1} and panicle weight.Maximum grainpanicle^{-1}was recorded in variety Torpan (159.6) and local variety Këmishtaj (144.9) These differences were significant compared with other varieties in study. Variety Flavia was found to be inferior for this trait (93.7). Significant differences exist for panicle weight (Table 1). but high panicle weight was not consistently associated with high grain yield. Among the cultivars higher PW values were obtained from Torpan and Bendo cultivars with (3.6 g both) while lower PW values were obtained from Flavia and Goka cultivars with 2.7 and 2.9 g respectively.

3.5. 1000 grain weight

Varieties significantly varied ($P<0.05$) for 1000-grain weight (1000-GW) This trait varied between 21.56 and 30.3 g. USO-32 and Flavia varieties had 30.3. and 29.8 g the 1000-GW respectively. Gele Van Timer variety had the lowest 1000-GW with 21.56 g. It is important to emphasize that 1000 grains weight did not vary significantly from one year to another. A number of authors (Chalmers et al. 1998; May et al. 2004; Browne et al. 2006) underlined that 1000- grain weight was a cultivar-specific trait with considerably higher variations being observed among genotypes than among treatments or environmental factors.

3.6. Dry matter (biomass) yield

The total dry-matter accumulation showed a linear increase for all varieties The data of table 1 showed significant differences among varieties in study. The highest DMY (16,39 t. ha^{-1}) was obtained from Argus variety followed by Gele Van Timer (16.31 t. ha^{-1}) and local variety Këmishtaj (16.08 t. ha^{-1}). The latest variety is well adapted in Albanian conditions for dual purpose, green fodder and grain production. They clearly indicate the genetic diversity of the genotypes due to their genetic constitution. The high DMY of the Gele Van Timer variety is the result of high plant height, while the Argus variety high DMY is the result of tillersm^{-2}. Torpan, Bendo, Visto and Flavia varieties also had higher biomass values and were placed in the same group with Këmishtaj variety. The lowest biomass was obtained from Goka variety with 15 t. ha^{-1}. Different biomass values in oat varieties were indicated by earlier studies.

Pathan et al. (2007) (Shah *et al*., 2002; Inan *et al*., 2005) observed that differences in green forage yield differed significantly due to varieties.

3.7. Harvest index (HI)

The HI is an important factor in crop production and its improvement has been one of the greatest achievements that differentiate commercial varieties from their wild intercessors (Donald, C.M., Hamblin, J. 1976, Gepts. 2004). Thus a high HI means that the allocation of carbon is directed to grain instead to biomass production and a high HI can be considered as a good trait in breeding high-yielding cultivars. In relation with two parameters (GY and DMY) in our study the harvest index (HI) also showed a high variation among varieties. According to Peltonen-Sainio et al. 2008, this confirms the complex nature of HI and its dependence on its components (vegetative biomass and grains). Based on three years' data of the research the highest HI was obtained from Goka variety (34.8), showed significant difference, compared with other varieties. It followed by Torpan (33.45) and Abed minor (33.07) that were in the same group. The lowest HI was obtained from Gele Van Timer variety (25.7). This variety seems to be the most suitable for the production of fodder because of its higher biomass yield, compared with other varieties in the study.

4. Conclusions

Based on the results of experiment carried out during three years, it may be concluded that under Centre Albanian conditions were observed significant ($p<0.05$) difference between oat varieties in study for grain yield and yield related traits. The highest grain yield was obtained from Torpan, Goka and Bendo. High grain yield of Torpan and Bendo was associated with high yield traits. So these two varieties are suitable for dual purpose (fresh fodder and grain yield).Their area should be increased, to replace the traditional variety Këmishtaj. Gele Van Time, Argus and Këmishtaj varieties are most suitable for fresh fodder because of their high biomass.

References

Browne, R.A., White, E.M., Burke, J.I. (2006). Responses of developmental yield formation processes in oats to variety, nitrogen, seed rate and plant growth regulator and their relationship to quality. *J. Agric. Sci. (Camb*.), 144, 533-545.

Buerstmayr, H., Krenn. N., Stephan. U., Grausgruber. H., Zechner. E. (2007). Agronomic performance and quality of oat (*Avenasativa* L.) genotypes of worldwide origin produced under Central European growing conditions. *Field Crops Research*., 101, 343–351.

Chalmers, A.G., Dyer, C.J., Sylvester-Bradley, R. (1998). Effects of nitrogen fertilizer on the grain yield and quality of winter oats. *J. Agric. Sci. (Camb.)*,131, 395-407.

Chohan, M., Naeem, S.M., Khan, M., Kainth, A.H., Sarwar, M. (2004). Forage yield performance of different varieties of oat. *Int. J. Agric. Biol*., 6, 751-752.

Dokuyucu, T., Akkaya, A. Nacar, A., Ispir, B. (1997). Investigation of some bread wheat cultivarsfor yield and phonological traits under Kahramanmaras conditions. Turkey II. *Field Crops Congress*, 16-20 (in Turkish).

Donald, C.M., Hamblin, J. (1976). The biological yield and harvest index of cereals as agronomic and plant breeding criteria. *Adv. Agron*., 28, 361–405.

Gepts, P. (2004). Crop domestication as a long-term selection experiment. *Plant breeding reviews,* 24(2), 1–44.

Inan, A.S., Ozbas, M.O. & Cagirgan M.I. (2005). Evaluation for agronomic and quality traits ofoat lines developed for food. *Turkey VI. Field Crops Congress,* 1153-1155 (in Turkish).

Holland, J.B. (1997). Oat improvement. In: Crop improvement for the 21st century (MS Kang ed). Research Signpost, Trivandrum, Kerala, India, 57-98.

Kibite, S., Baron, V., McCartney, D., Fairey, N. & Clayton, G. (2002b). Murphy oat. *Can. J. Plant Sci., 82*, 555-557.

May, W.E., Mohr, R.M., Lafond, G.P., Johnston, A.M., Stevenson, F.C. (2004). Early seeding dates improve oat yield and quality in the eastern prairies. *Can. J. Plant Sci*., 84, 431-442.

Pathan, S.H., Bhilare, R.L., Nawale, K.B. & Jadhav, V.T. (2007). Response of multicut oatvarieties to nitrogen levels. *Forage Research*, *32*(4), 269-270.

Peltonen-Sainio, P., Muurinen, S., Rajala, A., & Jauhiainen, L. (2008). Variation in harvest index of modern spring barley, oat and wheat cultivars adapted to northern growing conditions. *The Journal of Agricultural Science*, *146*(1), 35-47.

Shah, W. A., Bakht, J., Shafi, M., & Khan, M. A. (2002). Yield and yield components of different cultivars of wheat barley and oat under rainfed conditions. *Asian J. Plant Sci*, 1, 148-150.

Steel, R.G., Torrie, J.H. & Dickey, D.A. (1997). *Principles and procedures of statistics: A biological approach.* McGraw-Hill.

Stuthman, D.D. (1995). Oat breeding and genetics. p. 150–176. In R.W. Welch (ed.) *The oat crop: Production and utilization.* Chapman and Hall, London, England.

Welch, R.W. (Ed.). (2012). *The oat crop: production and utilization.* Springer Science & Business Media.

Yilmaz, H.A. & Dokuyucu, T. (1994). Determination of high yielding and suitable bread wheat genotypes for Kahramanmaras conditions. *In Turkey I. Field Crops Congress,* 303-306.