RESEARCH ARTICLE

Evaluation of oat accessions for different agronomic traits under agro-climatic conditions of narc Islamabad

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Abstract

Oat is one of the most commonly planted forages and a significant component of crop rotation in a farming system. Keeping in view the importance of oat crop, seven oat accessions were evaluated at National Agriculture Research Center, Islamabad during Rabi season 2020-21. Randomized complete block design with three replications with row to row distance 30 cm was maintained for sowing the aforementioned oat accessions. Significant variation was observed for all the studied traits except plant height and leaves tiller^{-1}. Highest mean values were observed for Jasper and Local Saryab for number of tillers plant^{-1} whereas Jasper was found to have maximum values for leaf area tiller^{-1} and leaf area index as well. Maximum flag leaf area was displayed by accession PP2-LV65 while the highest plant height was achieved by accession Local DIK. Maximum leaves tiller^{-1} was exhibited by S. 2000 while Local T.Jam achieved maximum green fodder yield and maximum dry matter yield t/ha. On the basis of high values for green fodder and dry matter yield Local T.Jam can be used for onward use for variety development.

Keywords: Oat; Germplasm; Agronomic traits; Fodder production and physiology

Introduction

Oat is one of the most often planted forages and a key component of crop rotation in a farming system, whether grown alone or in conjunction with the most prevalent annual legumes (Corleto, 1987). Its agronomic and nutritional qualities, as well as the growing popularity of organic agriculture, have reignited interest in this crop in recent few years. Furthermore, due to the fact that Oats are a good source of protein, carbohydrate, fiber, vitamins, minerals, and substances that are good for your health (e.g., polymers of fructose, and antioxidant molecules) (Peterson et al, 2005). Currently, the same oat cultivars used for fodder are also employed for grain production. Oat genotypes are typically chosen for high grain yield and harvest index, pest resistance, and/or resistance to environmental stress (Martinez et al., 2010). Fodder cultivars, on the other hand, must produce large volumes of highly digestible green fodder for animals, have strong regeneration ability after cutting, and be resistant to plant diseases that might limit fodder supply in producing regions (Stevens et al., 2004). The first

step in any breeding program is to determine the amount of variation that is present in the characters of agronomic importance within a large collection of materials in order to define the valuable populations to be considered further. Assessment of the genetic variability can be achieved using morphological measurements and phenotypic characterization (Greene et al., 2008). Bio-agronomic characterization using appropriate statistical methods is still a useful tool for the initial description and classification of oat collections, as it allows plant breeders to identify and select valuable genetic resources for direct use by farmers, breeding programs, or germplasm conservation and use planning (Achleitner et al., 2008).
The objectives of this study was to evaluate and explore and quantify the genetic variation of the main bio-agronomic traits and to define the oat genotypes for grain or fodder production that is applicable for breeding better accessions.

Materials and methods

The study titled "Evaluation of oat accessions for different agronomic traits under agro-climatic conditions of National Agriculture research council (NARC) Islamabad" was carried at national agriculture research center, Islamabad during Rabi season 2020-21. Twelve oat accessions (naming; No. 677, Australian, Local DIK, Local Sariab, Jasper, Local TandoJam, Local Lahore, No. 681, No. 708, Scott, PP2-LV65 and S. 2000) were laid out in RCB design (Randomized complete block) design with three replications. Seed rate of 40 kg per acre was kept and the field was irrigated according to the need of the crop. Other all-agronomic and cultural practices like, hoeing and weeding were carried out uniformly for all subplots.

Data measurement

Data on flag leaf area was calculated by measuring the length of flag leaf lamina from the base to the tip of lamina while flag width was measured from the middle portion of the lamina. Flag leaf area was, then, calculated using the following formula:
Flag leaf area = Flag leaf length × Flag leaf width × (Correction factor)
Plant height was measured in centimeters at maturity from ground level to the tip of panicle excluding awns using meter rod. Data on total tillers (productive and non-productive) were recorded by counted tillers from ten randomly selected plants in each entry and then average plant^{-1} was worked out. Total leaves were counted from ten randomly selected tillers in each plant and then average of leaves tiller^{-1} was worked out. Average leaf area tiller^{-1} was calculated by the following formula:

Leaf area tiller^{-1} = Tillers plant^{-1}×Leaves tiller^{-1}
Data on leaf area index was noted by using the following equation.

$$\text{Leaf area index} = \frac{\text{Total leaf area} \times \text{Tillers m}^{-2}}{10000}$$

Data on green fodder yield (t ha^{-1}) was determined after harvesting. The green fodder yield of selected plants was calculated by using balance and the average green fodder yield of the selected plants was computed in tons ha^{-1}. For data on dry matter yield (t ha^{-1}), a 27% dry matter yield was calculated from the calculated green fodder yield in tons ha^{-1}.

Statistical analysis

To get conclusive results of this experiment the field data was subjected to analysis of variance (ANOVA) procedure as recommended for alpha lattice design by Barreto *et al*. (1997). Least significant differences (LSD) test at 5% level of probability was used for means separation.

Results and Discussion

Flag leaf area (cm^2)

All the selected oat lines were observed significantly ($P<0.05$) different regarding flag leaf area (cm^2) (Table 1). Mean values of oat lines for flag leaf area (cm^2) ranged from 90.67 (cm^2) to 140.87 (cm^2). Among all accessions, PP2-LV65 gained maximum flag leaf area (cm^2) while No. 677 and Scott showed minimum flag leaf area (Table 2). Ak-Tahir (2014) tested oat genotypes and noticed significant variability for flag leaf area (cm^2).

Plant height(cm)

Mean values of oat lines for plant height ranged from 137.67 (cm) to 165.33 (cm). Among all accessions, Local DIK gained maximum plant height while No. 681 showed minimum plant height (Fig. 1). All the studied oat lines were observed non-significant ($P>0.05$) regarding plant height (Table 1). Al-Musa et al. (2021) studied oat genotypes and also found similar results for plant height

Tillersplant^{-1}

Results shows that all the selected oat lines were observed significantly ($P<0.05$) different regarding tillers plant^{-1}(Table 1). Mean values of oat lines for tillers per plant ranged from 4.33 to 7.66. Among all accessions, Local Saryab and Jasper gained maximum tillers plant^{-1}while No. 681displayed minimum tillers plant^{-1} (Table 2). Zaman et al. (2006) studied oat genotypes and noticed similar results for tillers per plant.

Table 1. Mean Square values of studied traits of oat lines sown at NARC Islamabad

Traits	Rep	Accessions	Error
Flag Leaf Area (cm^2)	15.84	1015.29	44.48
Tillers Plant^{-1}	0.04	41.39	15.33
Leaves per tiller^{-1}	0.02	0.42	0.40
Leaf Area Tillers^{-1}	1566.20	57531.80	12228.20
Leaf Area Index	0.35	12.94	2.75
Plant Height(cm)	181.03	151.36	266.64
Green Fodder yield (t ha^{-1})	100.31	202.15	93.65
Dry Matter yield (t ha^{-1})	7.31	14.74	6.82

Leaves tiller^{-1}

Statistical analysis was non-significant (P>0.05) regarding leaves tiller^{-1}(Table 1). Mean values of oat lines for leaves per tiller from 4.33 to 5.55. Among all accessions, S.2000 gained maximum leaves tiller^{-1}while PP2-LV65 showed minimum leaves tiller^{-1} (Table 2). Gurmani et al. (2021) tested oat genotypes and also found similar outcomes for leaves tiller^{-1}.

Leaf area tiller^{-1}

All the selected oat lines were observed significantly (P<0.05) different regarding leaf area tiller^{-1}(Table 1). Mean values of oat accessions for leaf area tiller^{-1} ranged from 478.73 (cm^2) to 936.63 (cm^2). Among all accessions, Jasper gained maximum leaf area tiller^{-1}while No. 708 showed minimum leaf area tiller^{-1} (Table 2). Bibi et al. (2021) evaluated oat germplasm and also noticed significant variability for leaf area tiller^{-1}.

Leaf Area Index

All the selected oat lines were observed significantly (P<0.05) different regarding leaf area index (Table 1). Mean values of oat lines for leaf area index ranged from 7.18 to 14.05. Among all accessions, Jasper gained maximum leaf area index while No. 708 showed minimum leaf area index (Table 2). Celik and Erten (2021) tested oat genotypes noticed significant variability for leaf area index.

Green fodder yield (t ha^{-1})

All the selected oat lines were observed significantly (P<0.05) different regarding green fodder yield t ha^{-1}(Table 1). Mean values of oat lines for green fodder yield ranged from 67.13 t/ha to 92.13 t/ha. Among all accessions, Local T. Jam gained maximum green fodder yield t ha^{-1}while PP2-LV65 showed minimum green fodder yield t ha^{-1} (Fig. 2). Jayashi et al. (2021) evaluated oat varieties and noticed significant variability for green fodder yield.

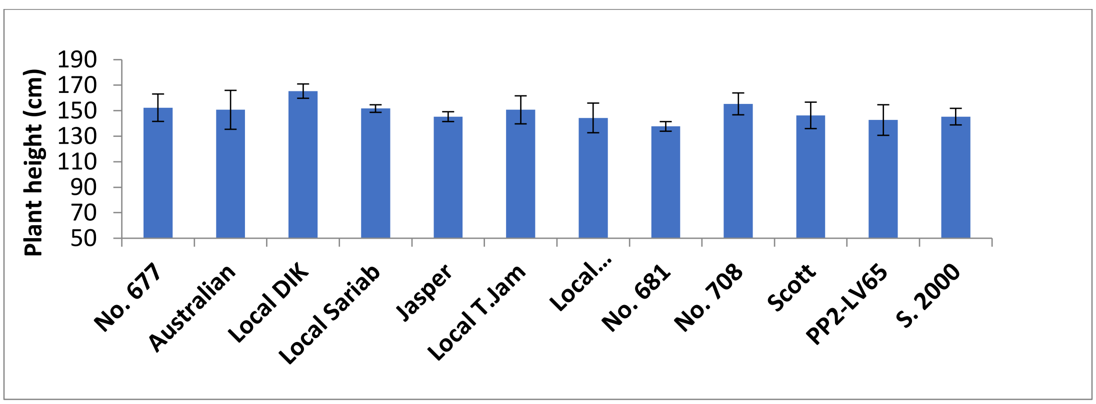

Figure I. Mean values and error bar graph for plant height

Dry Matter yield (t ha^{-1})

All the selected oat lines were observed significantly (P<0.05) different regarding dry matter yield t ha^{-1}(Table 1). Mean values of oat lines for dry matter yield ranged from 18.13 t/ha to 24.88 t/ha. Among all accessions, Local T. Jam gained maximum dry matter yield t ha^{-1}while PP2-LV65 showed minimum dry matter yield t ha^{-1} (fig. 3). Dangi (2021) studied oat genotypes and noticed similar results for dry matter yield.

Table 2. Flag leaf area, tilers plant-1, leaves per tillers, leaf area per tiller and leaf area index of different oat lines sown at NARC, Islamabad

Oat lines	Flag Leaf Area (cm^2)	Tillers Plant^{-1}	Leaves per tiller^{-1}	Leaf Area Tillers^{-1}	Leaf Area Index
No. 677	90.67	5.88	5.00	532.94	7.99
Australian	127.48	5.88	5.33	749.97	11.25
Local DIK	137.84	4.89	4.89	673.68	10.11
Local Sariab	107.83	7.66	5.00	826.14	12.39
Jasper	121.93	7.66	5.44	936.63	14.05
Local T.Jam	124.71	5.55	5.44	693.73	10.41
Local Lahore	102.71	4.88	4.61	499.65	7.49
No. 681	134.28	4.33	5.00	583.39	8.75
No. 708	93.59	5.11	5.22	478.73	7.18
Scott	90.67	7.33	5.44	663.46	9.95
PP2-LV65	140.87	5.66	4.33	798.33	11.97
S. 2000	120.63	5.44	5.55	652.48	9.79

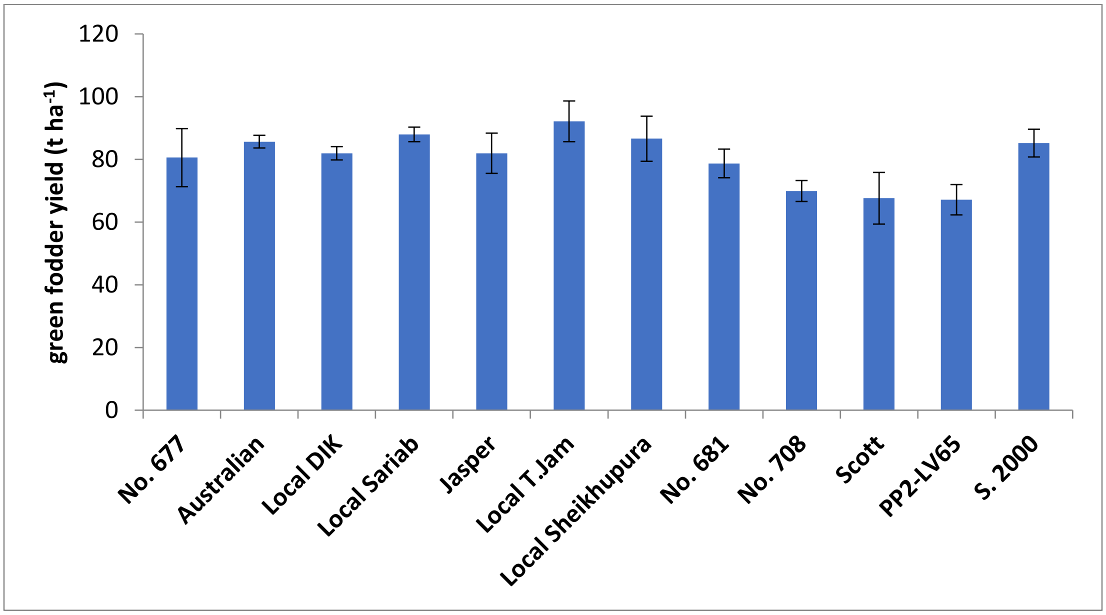

Figure 2. Mean values and error bar graph for green fodder yield t ha^{-1}

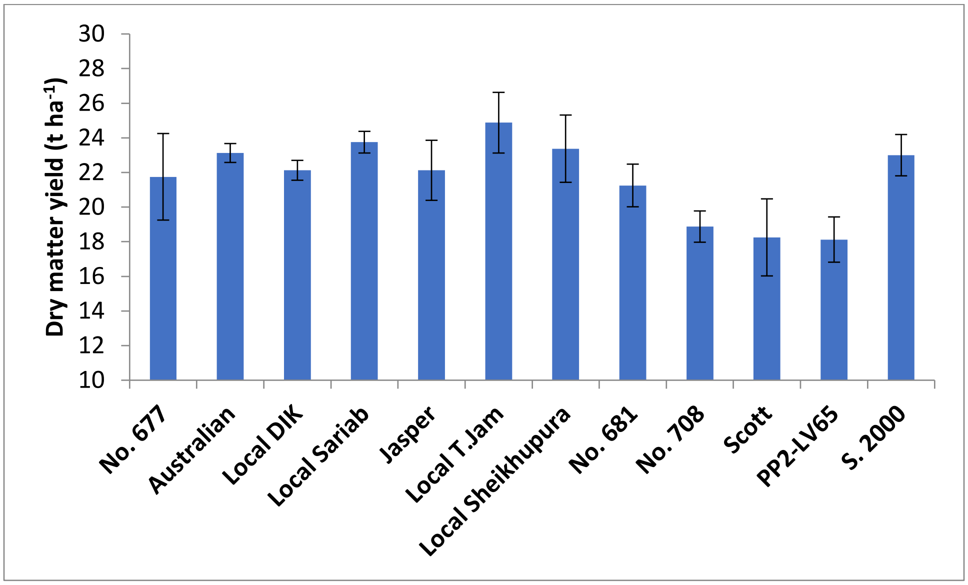

Figure 3. Mean values and error bar graph for dry matter yield t ha^{-1}

Conclusion

It was concluded that oat lines sown in NARC Islamabad significantly differed for studied traits excluding plant height and leaves tiller^{-1}. Oat genotype Jasper and Local Saryab produced higher number of tillers plant^{-1} while Jasper produced greater leaf area tiller^{-1} and leaf area index. The higher green fodder yield and dry matter yield t/ha was achieved by Local T. Jam and hence it could be selected for cultivation and may be include in the future oat breeding program.

Declaration

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Data availability: From the author

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