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Response of *Avena sativa* L. intercropping with Egyptian clover to different planting density and distances in green fodder yield

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ABSTRACT

The experiment was conducted during winter of the season 2019-2020 in the fields of the field crops department – Agriculture college / Al-qasim green university, to investigate the response of green fodder yield to planting density and plant distances, A factorial arrangement in randomized complete block design with three replications was used, first factor was included plant density : D1 (50% oat = 60 kg ha^{-1} + 50% berseem = 20 kg ha^{-1}), D2 (60% oat = 72 kg ha^{-1} + 40% berseem = 16 kg ha^{-1}) and D3 (40% oat = 48 kg ha^{-1} + 60% berseem = 24 kg ha^{-1}), second factor was included : A1 (15 cm among lines) and A2 (30 cm among lines). The treatment (D2) was superior in leaf area, chlorophyll content, green fodder yield and percentage of protein while (D3) was superior in number leaves per plant, treatment (A2) was superior in all study traits, A linear relationship was found between planting density with plant distances was found in treatment (D2 × A2) in leaf area, number of leaves per plant, chlorophyll content and green fodder yield while the treatment (D2 × A1) was superior in percentage of protein .

Key words : *Oat, Avena, Planting density, Plant distance, Green yield*

Introduction

Livestock have operated important place and essential in stable agricultural system because of its active role in achieving food security. The decline in productivity forage limit forage resources, fodder inability is necessary and sufficient for the animals as well as higher prices is one of the problems that stand in front of the evolution, development of these wealth and cover the current deficit in animal products due to grow demand. Forage mixtures is known as feeds consisting of two crops or more are often planted randomly either single or intercropping, the competition in this case are among crops on environmental factors and soil factors, the intercropping among plants determines the optimal use of growth conditions and thus affect the amount of vegetative growth and nutritional value of forage (Jabbar, 2010; Jabbar, 2014). Forage mixtures consist of crops (cereal-legume) important source of energy and the contents of protein, carbohydrate and mineral elements. In the forage mixture, The cereal component is a source of carbohydrate and legume source component provides proteins in forage (Jabbar, 2013). Nutritionally balanced forage is obtained from mixtures of leguminous and grassy forage had been mainly motive to plant forage mixtures.

Oats (*Avena sativa* L) an annual herbaceous fodder crop of the grassy family, is ranked second after

barley in terms of grass fodder globally, in addition to a fodder crop that has other used in the medical fields, as there are benefits for humans without side effects on public health when Its use in comparison with chemical treatments and a course in children's nutrition and the protein in contains.

The planting methods has directly been affecting in green fodder yield of Oat which is intercropped with berseem , the green fodder yield has affected in forage cereals by the method of planting that directly affects on the nature and speed of the growth of the plant. Ul Haq *et al.* (2020) found from study the geometric distribution of the overlapping planting between cereal and legume crop, the cultivation of oats with forage leguminous crops gave different rates of dry matter, cultivation of oats individually did not give the highest dry matter yield, but the treatments 75 oats: 25 leguminous crops and 50 oats: 50 leguminous crops gave the highest dry matter yield (Neugschwandtner and Kaul, 2014), the reason for this increase in dry matter yield is the role of the legume crop in providing nitrogen to the oats, in addition to the increase in the accumulation of elements such as nitrogen in the vegetative part of the plant.

Irfan *et al.* (2016) noted in his study of two seasons that the experiment included four varieties of oats and planting distances, the distance 12 cm gave 13.7 tons ha^{-1} compared to the 46 cm treatment which gave 10.4 tons ha^{-1}. So this study was conducted for determining the optimal planting method for a mixture of oat plants, plant density of oats intercropping with berseem and their effect on the yield of green fodder and to know the effect of the overlap between planting lines and the ideal distance between them.

Materials and Methods

The experiment was conducted during winter season 2019-2020 in the fields of the field crops department – Agriculture college / Al-qasim green university, The experiment was carried out as a factorial experiments arrangement into Randomized Complete Block Design with three replications, first factor was planting methods : first factor was included plant density : D1 (50% oat = 60 kg ha^{-1} + 50% berseem = 20 kg ha^{-1}), D2 (60% oat = 72 kg ha^{-1} + 40% berseem = 16 kg ha^{-1}) and D3 (40% oat = 48 kg ha^{-1} + 60% berseem = 24 kg ha^{-1}), second factor was included : A1 (15 cm among lines) and A2 (30 cm among lines).

Analysis of variance (ANOVA) and means comparison was carried out by L.S.D. test under incorporeity level 5% (Dawood and Elias, 1990) with S.A.S. program (SAS, 1992) .

Treatments was randomized distributed in (4×3) m^2 plot, distance among sub-plots 0.5 m and lines 20 cm (Ross *et al.*, 2005), time of planting 17/11/2019 (16), N fertilizer added Urea (46%) in rate (20 kg N/h) on two defrayments : first at planting stage, second after 30 days from first (Zaki, 1993), Studies traits was :

Leaf area – No. leaves per plant – chlorophyll content – green fodder yield –percentage of protein, soil of the field was checked to know (physical and chemical traits) in Soil Department laboratories / college of agriculture. The result are shown in Table 1.

Table 1. Physical and chemical analysis for soil before planting

Studies traits Rate	Value
pH	7.8
Ec	3.1 ds m^{-1}
Sand	30.5 %
Clay	38.4 %
Silt	29.8 %
Texture	Admixture Clay

Results and Discussion

Leaf area

The results (Table 2) showed that there are significant differences when using different plant densities in the characteristic of the leaf area, the treatment D2 gave the highest average for this characteristic 34.66 cm^2. The reason for the increase in leaf area is that the increase in plant density leads to a state of symbiosis between plants to resist environmental conditions (Peker *et al*., 2020). The results showed significant differences in planting distances in the characteristic of the leaf area, there was a direct increase with the increase in planting distances, treatment A2 gave the highest average leaf area 35.01 cm^2, the increase in the distance between the lines gave an opportunity to grow and increase the leaf area due to the lack of competition between plants and thus an increase in the process of cell division, and in turn, the increase in the surface area of the leaves. It noted that there are significant differences

in the bilateral overlap between plant density and planting distances in the characteristic of the leaf area, as the combination D2 * A2 gave the highest average of the leaf area of 37.36 cm^2.

Number of leaves per plant

The results (Table 2) indicated that there are significant differences when using different plant densities in the characteristic of the number of leaves. Treatment D3 gave the highest average number of leaves, reaching 7,156 leaves / plant, compared to treatment D1, as it gave the lowest average of 5,378 leaves / plant. The reason for the increase in leaves is attributed to the difference in plant density, as competition between plants of the same type decreased, and thus the number of phalanges increased in the plant, and this reflected positively on the increase in the number of leaves in the plant (Jabbar, 2014). Significant differences were evident when planting distances are used in the characteristic of the number of leaves, as treatment A2 gave the highest average number of leaves which reached 6.956 leaves/plant. The reason for the increase in the number of leaves is due to the difference in planting distances, as the high distances created an opportunity for the plant to give a high foliage as a result of the high assimilation of light and all the growth requirements and this is consistent with the results of each of (Majid and Salim, 2018; Hameed *et al.*, 2014). The results indicated that there is a significant difference between plant density and planting distances in the characteristic of the number of leaves in the plant, as the combination D2 * A2 gave the highest average number of leaves, which reached 7.767 leaves/plant.

Chlorophyll content

It was evident through the results (Table 2) that there are significant differences when using different plant densities in the characteristic of the leaf content of chlorophyll, treatment D2 gave the highest average for this characteristic 52.98. The reason for this may be attributed to the increase in seed quantities, Dordas *et al.* (2012) confirmed in his experience that the cultivation of forage grass crops was intertwined with forage leguminous crops under different seed rates that showed a significant variation in the chlorophyll leaf content at different seed rates and this percentage increased with the increase in densities. The results showed that there is a significant difference when using planting distances in the characteristic of the leaf content of chlorophyll, treatment A2 gave the highest average for this characteristic 52.71. Which encouraged the formation of a wide shoots and thus reflected positively on the chlorophyll content of leaves in the plant and this is in agreement with Gong (2011). It was evident that the effect of the bilateral overlap between plant density and planting distances was significant in the characteristic of leaf content of

Table 2. effect plant density on study trait

Factors	Leaf area (cm^2)	No. leaves per plant	Chlorophyll content (SPAD)	Green fodder yield (kg/ha^{-1})	Percentage of protein (%)
Plant density					
D1	31.20	5.378	46.36	15.81	12.14
D2	34.66	7.022	52.98	22.11	13.34
D3	33.50	7.156	52.83	20.58	12.14
$L.S.D_{.05}$	0.680	0.0989	0.577	0.521	0.676
Plant distances					
A1	31.01	6.081	48.74	17.87	11.91
A2	35.23	6.956	52.71	21.13	13.18
$L.S.D_{.05}$	0.555	0.0807	0.471	0.425	0.552
Plant density ˆ Plant distances					
D1A1	29.47	5.067	44.99	14.81	11.09
D1A2	32.93	5.689	47.73	16.80	13.20
D2A1	31.97	6.278	50.32	19.67	13.47
D2A2	37.36	7.767	55.63	24.55	13.21
D3A1	31.60	6.900	50.90	19.14	11.16
D3A2	35.40	7.411	54.76	22.03	13.12
$L.S.D_{.05}$	**0.962**	**0.1378**	**0.816**	**0.737**	**0.956**

chlorophyll, the combination D2 * A2 gave the highest average for this characteristic 55.63.

Green fodder yield

It is noticed in Table 2 that there are significant differences for plant densities in the quality of the green fodder yield, there was a direct increase with the increase in plant density, treatment D2 gave the highest average of 22.11 ton/ha. The reason is the increase in the Green fodder yield as a result of increasing leaf area and Number leaves per plant and chlorophyll leaf content as shown in Table 2. The results indicate that there is a significant difference when planting distances are used for the yield of green fodder. It noticed that there is a positive increase with the increase in planting distances for all levels. Treatment A2 gave the highest average for green fodder yield 21.13 ton/ha. The reason for the increase in the yield of green fodder is attributed to the superiority in the characteristic of plant height, leaf area, number of leaves per plant and leaf content of chlorophyll, as shown in the Table 2. The results indicated that there is a significant difference in the bilateral overlap between plant density and planting distances in the attribute of the ratio of green fodder yield, there was a direct increase with the increase in planting distances D2 * A2 gave the highest average for this characteristic 24.55 ton / ha.

Percentage of protein

The results (Table 2) indicated the presence of significant differences using different plant densities in the percentage characteristic of protein, treatment D2 gave the highest average for this characteristic 13.34%. The reason for this is attributed to the increase in the leaf area and the chlorophyll content of the leaves, which reflected positively on the protein percentage as in the Table 2. The results showed that there were significant differences using the planting distances for the characteristic of protein percentage, treatment A2 gave the highest average of 13.18%. The reason for the increase in the percentage of protein is attributed to the increase in the yield of dry feed, leaf area and leaf content of chlorophyll, as shown in the Table 2. there was a direct increase with the increase in planting distances D2 * A1 gave the highest average for this characteristic 13.47 %.

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