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Fodder Yield and Quality of Rhodes Grass-Alfalfa Mixtures as Affected by Sowing Rates in Makkah Region

Ahmed A. Bakhashwain

Department of Arid Land Agriculture,
Faculty of Meteorology, Environment and Arid Land Agriculture,
King Abdulaziz University Jeddah, Saudi Arabia

Abstract. This research was conducted at the Agriculture Research Station, Hada Al-Sham, K.A.U., to study the effects of different sowing ratios (proportions) of Alfalfa, (*Medicago sativa.*) - Rhodes grass (*Chloris gayana*) (100:0, 0:100, 50:50, 75:25, and 25:75, respectively) on green fodder yield and quality, to compare the yield and quality of alfalfa and Rhodes grass fodder, sown alone and in mixtures, and finally to determine the suitable mixture ratio of both under Makkah region ecological conditions.

The results showed that the number of plants per two meters row was influenced by different sowing ratios of alfalfa and Rhodes grass. Plant heights, number of leaves and fresh weight per plant were also significantly affected by different ratios. Leaves fresh and dry weights also showed high significant differences among the different sowing ratios. Sowing ratio of 100: 0 (alfalfa: Rhodes) gave the highest number of plants/2m row (238.9 plants/2m row), the lowest plant heights (29.003cm), the maximum number of leaves (67.27 leaves/plants), the lowest fresh weight per plant (3.16g/plant) and the lowest leaves fresh weights (1.08g). Moreover, sowing ratio of 0:100(alfalfa: Rhodes) was recorded to have the highest plant heights (87.25cm), the lowest number of leaves (20.8 leaves/plants), the maximum fresh weight per plant (17.16g) and the highest leaves fresh weight (5.5g). The highest green fodder and dry fodder yield (1615.94 kg/ha) and (159.89 kg/ha) respectively were recorded for sowing ratio of 100% Rhodes grass. The lowest dry matter percentage was also observed for alfalfa sown alone, with high significant differences with all other sowing ratios. The crude protein (CP) (%), crude fiber (CF) (%) and ash contents (%) were significantly affected by the different sowing ratios. Alfalfa fodder (100%) contained the highest crude protein content (17.17%), and ash % (10.0%), while the highest crude fiber (%) was produced from the mixture of 75% and 100% Rhodes grass with values of 17.99% and 17.3% respectively.

Introduction

One of the main objectives of the national agricultural development in the Kingdom of Saudi Arabia is to reduce the importation of fodder grain, forage plants and animal products; perhaps, to sustain self-sufficient in both sectors. The costs of forage, fodder grain and concentrate feed importation have been increased during the last few years, because of the reduction in fodder or forage production in the Kingdom. The Kingdom of Saudi Arabia is characterized by a large number of livestock (camels, sheep, goats, cattle) which can be estimated to be about 3.5 million heads that are raised on poorly dry desert rangeland.

Generally, forage (fodder) crop production plays an important and effective role in agriculture economical development. The main and most traditional approach to livestock production in Saudi Arabia is grazing desert rangeland year-round, but mostly during a period of 3 to 4 months of better rangeland productivity. Eventhough, high-quality forage is available from the market (cultivated alfalfa hay) with the possibility of increasing prices during the period of low quantity rangeland forage as dry season begins, as well as, during the peak of livestock marketing time (during Ramadan, the two Eids and Al-Hajj).

Fodders are the most valuable and cheapest source of food for livestock having rich source of metabolizable energy, nutrient elements, carbohydrates and protein. With quality nutritional fodder, milk production can be increased up to 100% (Maurice *et al.,* 1985). Generally, good quality forage is high in protein and digestible nutrients, and low in fiber and lignin. Also, animal performance is a better indicator of forage quality.

Legume crops constitute a major group of crops in the world. They provide human food, animal feed and material for industrial uses. Their nutritional value as a source of protein has long been recognized. However, only recently legume crops have risen to prominence in the Kingdom of Saudi Arabia (Al- Tahir *et al*., 1989).

In view of the global warming, increasing water shortage, deteriorating natural resources base and growing demand for alternative (fodder) forage resources of high quality to meet the (fodder) forage requirements of increasing livestock population among few other (fodder) forage plants, provide useful crop options.

Alfalfa, (*Medicago sativa.* L) which means "best fodder" in the Arabic language, is also known as Lucerne in most of the world. It is called "queen of the forages" because it is a long-lived perennial legume and most animals prefer to eat alfalfa to all other types of fodder. Rhodes grass (*Chloris gayana*) is tufted perennial with runners, suited to subtropics, combines well with many legumes and is used as fodder crop for domestic animals. The forage yield and quality advantages of including alfalfa in a mixture with grasses species are well-known (Van Keuren and Matches, 1988).

Pastures and fodder crops are the cheapest form of animal feed available (in term of quantity and quality). A constant supply of good quality forage in sufficient quantities is a basic necessity in livestock farming. The forage quality of cereal hay is generally lower than that required to meet production goals for many livestock classes, whereas legume-cereal mixtures are important protein and carbohydrate sources for livestock (Karadau, 2003). Thomas, *et al.* (1984) conducted a field experiment, with sorghum alone (50 kg/ha) and intercropping with cowpea seed mixture (45+5, 40+10, 35+15 and 30+20 kg/ha) and concluded that increasing proportion of cowpea in mixture increased fresh fodder yield, ash and protein contents in dry matter but decreased dry matter content.

Mixed cropping especially with legumes can improve both forage quality and yield because legumes are good source of protein (Moreira, 1989; Toniolo *et al.,* 1987; and Khandaker 1994). High proportion of legumes is undesirable since these normally have a low dry matter contents and are susceptible to lodging (Gilliland and Johnston, 1992). Growing of sorghum and maize in mixture with cowpeas and soybeans in 1:1 and 2:1 row proportions produced more fresh weight, dry weight and crude protein than their sole planting (Chellaiah and Ernest, 1994). The growing of fodder crops in mixture with legumes enhanced fodder palatability and digestibility (Chaudhary and Hussain, 1985). The relative proportion of the component crops in mixture is an important factor determining yield, quality and production efficiency of a cereal-legume mixture (Willey and Osiru, 1972).

In general, mixtures gave higher green forage yields than the pure stands. The same has been reported by many other researchers (Osman and Nersoyan, 1985; Tukel *et al.,* 1997; and Karadau, 2003). In addition, Karadau (2003) reported that the average green forage yield obtained

from the pure barley plots was not statistically different from the average green forage yields obtained from the mixtures (75% vetch + 25% barley and 50% vetch + 50% barley).

In experiments conducted with a wheat-hairy vetch mixture, Roberts, *et al.* (1989) obtained mean dry matter yields between 5.1 and 8.3 t ha^{-1}. However Karadau (2003) reported that the dry matter yields of the pure sowings and mixtures were significantly different ($P < 0.01$) in both years. The highest dry matter yield (9.04 t ha^{-1}) was from the mixture containing 25% vetch and 75% barley, and the lowest yield (0.97 t ha^{-1}) was from the pure vetch sowing. Rynolds, *et al.* (1982), Osman and Nersoyan (1985) and Karadau (2003), reported that mixtures gave higher yields than pure sowings. However, the average dry matter yield of pure barley was not statistically different from those of the mixtures (Karadau, 2003). Rynolds, *et al.* (1982), Tukel, *et al.* (1997) and Kukten and Tansõ (1999) indicated that the most suitable mixture for forage production was 25% legume and 75% cereal. Although Roberts, *et al.* (1989) and Tukel, *et al.* (1997) found similar results, Karadau (2003) indicated that, dry matter yields were higher, resulting in higher crude protein yield than in the above-mentioned experiments. Khot, *et al.* (1992) also reported higher dry matter yield in pure stand of maize, whereas the higher crude protein yields (0.78 t/ha) in pure stand of *Crotalaria juncea.*

The higher percentage of crude protein was recorded in cowpeas grown alone than that of the pure stand of maize (Ibrahim *et al.,* 2006). The lowest crude protein concentration was obtained from pure barley while the highest crude protein concentration was obtained from pure grasspea (Karadau, 2003). Nonetheless, since the crude protein concentrations of legumes are higher than those of cereals, the crude protein concentrations of the mixtures increase as the legume rate increases in the mixture (Droushiotis, 1989; Roberts *et al.,* 1989 and Tan and Serin, 1996). Tukel *et al.* (1997) showed that the mean dry matter yields varied between 0.98 and 2.69 t ha^{-1} and crude protein yields were between 0.54 and 0.98t ha^{-1}. Tan and Serin (1996) reported that the average crude protein yield between 0.529 and 0.583t ha^{-1} with common vetch + barley mixtures under Erzurum conditions.

The seeding rates of companion or mixed crops ranged from 9kg ha^{-1} (Lanini *et al.,* 1991) to 168 kgha-1 (Janson and Knight, 1973) in most companion crop studies. It was suggested that the companion crop should

be sown at low density (Lanini *et al.,* 1991) and to be harvested as a forage crop instead of a grain crop (Miller and Stritzke, 1995).

The major objective of this study was to determine the effects of different sowing rates of barley-alfalfa as a companion crop on the fodder yield and production, as well as, fodder quality under Makkah region ecological conditions. It was also intended to compare the yield and quality of Rhodes grass (*Chloris gayana*) fodder and alfalfa (*Medicago sativa.*) fodder, sown alone and in mixture with each other in different proportions, and to determine the suitable mixture rate of alfalfa legumes and Rhodes grass, as well as, improvement of the land use efficiency using the legume-grass mixture forage crop.

Materials and Methods

The experiment was laid out in a randomized complete block design with four replications. The alfalfa- rhodes grass mixture treatments and seed proportions of alfalfa and rhodes grass were 100:0, 0:100, 50:50, 75:25, and 25:75, respectively. Treatments of the mixture were conducted in form of row ratios as follows: T1 (100% alfalfa); all rows were planted with alfalfa, T2 (100% Rhodes grass); all rows were Rhodes grass, T3 (50% alfalfa + 50% rhodes grass); one row rhodes grass then one row alfalfa and so on with the same sequence, T4 (75% alfalfa + 25% Rhodes grass); 3 rows alfalfa then one row Rhodes grass and so on with the same sequence, and T5 (25% alfalfa + 75% Rhodes grass); one row alfalfa then 3 rows Rhodes grass and so on with the same sequence.

Seed rate for 100 percent Rhodes grass and alfalfa was 40 and 80kg per hectare, respectively. The fodder crop was sown in plots measuring 2 x 3meter on a well prepared seed bed in 20cm apart rows. NPK fertilizers with a rate of (100 kg/ha) were applied at sowing. Nitrogen fertilizers (50 kg/ha) was applied after six weeks from planting. All other cultural practices were kept normal and uniform for all treatments. Fodder plants were harvested after six weeks from planting and left for re-growth for other six weeks before last harvest. The following measurements were obtained for each harvest:

- Yield and quality parameters were measured as**:** green fodder yield (kg/ha), dry matter yield (t/ha), dry matter (%), crude protein (%), crude fiber (%) and ash (%).

- Growth characteristics were measured as: plant population (plants/m²), number of plants/2m row, plant height (cm), number of leaves/plant, and leaves weight (g), fresh and dry plant weight (g/plant) for each crop on 10 random plants/plot, as well as dry weight (%)**.**
- Statistical design and analysis were done according to Steel and Torrie (2000).

Results and Discussion

Data in Table 1 show that plant population in terms of number of plants per two meters row was influenced by different fodder crop sowing ratios of alfalfa and Rhodes grass. The highest number of plants per two meters row (238.9 plants/2m row) was recorded in the second cut, where alfalfa was sown alone. It was also recorded in the second cut, that rows in plots where ratio was 25:75 (alfalfa: Rhodes grass) obtained closely higher number of plants per two meters row (193.58 plants/2m row). This might be in agreement with Ibrahim, *et al.* (2006), who reported that rates of 75:25 (maize: cowpea) gave maximum plant population. The lowest number of plants (139.33 plants/2 m rows) was recorded in plots of 50:50 ratio with a significant difference with plots where Rhodes grass was sown alone or Rhodes grass: alfalfa (75:25).

Plant heights (Table 1) were significantly affected by the fodder crop mixtures. The highest heights (85.5cm) and (87.25cm) for the two cuts were recorded when the Rhodes grass was sown alone, and the lowest heights (29.003cm and 32.34 cm) were recorded when alfalfa was sown alone. The plant height data in (Table 1) show that, when the ratio of alfalfa increases in the mixture, the plant height significantly decreases. This might be as a result of the growth formation of Rhodes grass and for the effects of competition for light. The plant height results can be relatively supported by other authors (Hong *et al.,* 1987 and Ibrahim *et al.,* 2006).

Number of leaves per plant (Table 1) showed no significant differences among all sowing ratios in the second cut, except 50:50 ratio. However, in the first cut, there was higher significant differences between the two fodder crops (67.27 leaves/plant) when alfalfa or Rhodes grass were sown alone, and (25.62 leaves/plant) when Rhodes grass was sown alone. Among all sowing ratios, Rhodes grass sown alone gave the lowest number of leaves (20.8 leaves/plants) in the second cut.

Table 1. Means of plant population (in 2m row), plant height (cm) and number leaves per plant under different sowing ratios of alfalfa: Rhodes grass fodder mixtures.

Sowing Ratio Alfalfa :Rhodes	Means					
	Plant Population (Number of Plant / 2m row)		Plant height (cm)		Number of leaves per plant	
	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
100 : 0	128.68b	238.9a	29.03d	32.34d	67.27a	30.55ab
0 : 100	161.15a	176.95b	85.08a	87.25a	25.62c	20.80b
50 : 50	139.33b	166.15b	52.88c	57.75b	34.92bc	36.45a
75 : 25	173.53a	188.25b	44.01c	47.68b	46.8b	25.62ab
25 : 75	129.8b	193.58a	69.05b	77.36a	30.55c	36.85a

Means followed by the same letters are not significantly different according to LSD at ($P< 0.05$).

Maximum number of leaves was obtained from the ratio of 100: 0 (alfalfa was sown alone in the first cut). It can be observed that increasing the ratio of alfalfa over Rhodes grass increased the number of leaves per plant.

Fresh and dry weights are presented in Table 2. The maximum fresh weight per plant (17.16g/ plant) was recorded for Rhodes grass in the second cut when sown alone, followed by the same sowing ratio (11.94g/ plant) in the first cut. The ratio of 25 alfalfa: 75 Rhodes grass came second (11.93 and 10.21g/ plant) for 2nd and 1st cut respectively. The lowest fresh weights per plant (3.33 and 3.16g/plant) were recorded when alfalfa was sown alone from 2nd and 1st cuts respectively. As a result, the lowest value dry weights per plant were produced for 100% Rhodes grass ratio.

Leaves fresh and dry weights means (Table 2) showed high significant differences among the different sowing ratios in the two cuts. The lowest leaves fresh weights (1.08g and1.86g) were recorded for alfalfa that was sown alone, and the highest weights (4.47g and 5.56g) were recorded for Rhodes grass sown alone. However, the differences between the two ratio treatments were not significant.

As for leaves dry weight under the different sowing ratios, data presented in Table 2 revealed that the highest leaves dry weight were obtained under the 25% alfalfa: 75% Rhodes fodder (2.55 and 3.02 g) in the first and the second cuts, respectively, and 100% Rhodes fodder (2.78 and 2.91 g) in the two cuts respectively, while the 100% alfalfa produced the lowest dry weight in the two cuts.

Fresh green fodder yield /ha (Table 3) showed that the highest fresh yield /ha was produced from100% Rhodes fodder in the second and first cuts (1615.94 and 1045.04 kg respectively), while the lowest yields were produced under the 100% alfalfa in the first and the second cuts. The same trend was found for the dry green fodder yield /ha as shown in Table 3. These results might be in agreement with the results of Khot, *et al.* (1992) and Ibrahim, *et al.* (2006).

Crude protein content (%) of the dry fodder plants as an average of the two cuts (Table 3) revealed that the highest values were recorded from the 100% alfalfa (17.17%) and 75% alfalfa (16.94%), while the lowest value was obtained from plants of 100% Rhodes grass (8.11%). Crude fiber (%) was highest from 75 and 100% Rhodes grass (17.99 and 17.3 %), respectively. Alfalfa plants (100 and 75%) had the highest ash contents (10.36% and 10.87%, respectively), while the lowest value was produced from plants of 100% Rhodes grass (Table 3).

Table 2. Means of plant fresh and dry weight (g), Leaves fresh and dry weights (g) and dry weight (%) under different sowing ratios of alfalfa: Rhodes grass fodder mixtures.

Sowing Ratio Alfalfa: Rhodes	Means							
	Plant fresh weight (g)		Plant dry weight (g)		Leaves fresh weight (g)		Leaves dry weight (g)	
	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
100 : 0	3.16c	3.33d	0.679d	0.711d	1.08d	1.86b	0.45d	0.84c
0 : 100	11.94a	17.16a	4.679a	6.72a	4.47a	5.56a	2.78a	2.91a
50 : 50	7.30b	7.61c	2.838b	2.96c	2.42c	2.7c	1.54b	1.84b
75 : 25	4.94bc	6.38c	1.66c	2.143c	2.07c	2.57c	1.22b	1.64b
25 : 75	10.21ab	11.93b	3.77b	4.40b	3.67b	4.02b	2.55a	3.02a

Means followed by the same letters are not significantly different according to LSD at ($P< 0.05$).

Table 3. Means of fresh and dry green fodder yield (kg/ha), crude protein (%), crude fiber (%) and ash contents (%) under different sowing ratios of alfalfa: Rhodes mixtures.

Sowing Ratio Alfalfa :Rhodes	Fresh green fodder yield (kg/ha)		Dry green fodder yield (kg/ha)		Means		
	1st cut	2nd cut	1st cut	2nd cut	Crude protein (%)	Crude fiber (%)	Ash (%)
100 : 0	585.58c	617.09d	64.350c	70.96c	17.17a	16.1c	10.36a
0 : 100	1045.042ab	1615.94a	94.05a	159.89a	8.11d	17.3a	8.32c
50 : 50	845.36b	880.77c	84.33ab	94.16b	16.78b	16.98b	9.71b
75 : 25	614.123c	801.76c	73.68bc	104.22b	16.94b	16.72b	10.87a
25 : 75	989.12a	1153.83b	128.57a	161.53a	10.54c	17.99a	9.6b

Means followed by the same letters are not significantly different according to LSD at ($P< 0.05$).

The results of this study are in agreement with many researchers (Toniolo *et al.,* 1987; Mohapatra and Pradhan, 1992; Ibrahim *et al.,* 2006), who reported that, introducing legume fodder plants with cereal plants or grasses, will increase protein contents.

Generally, mixing of legumes in cereal or grass fodder is a better way to increase the quality of cereal or grass fodder. That is because fodder quality of grassy hay is lower than that required to meet production goals for many livestock classes, whereas legume-cereal mixtures are important protein and carbohydrate sources for livestock (Karadau, 2003).

Also, Thomas, *et al.,* (1984) reported that increasing proportion of cowpea in mixture increased fresh fodder yield, ash and protein contents in dry matter, but decreased dry matter content. However, this was not the same according to the results of this experiment, where the increased proportion of grass to legume, increased green and dry matter yield and improved the quality of the fodder.

Regarding dry matter, increased grass proportion increased dry matter, and the results of this study were in agreement with those of Toniolo, *et al.* (1987) and Khandaker (1994) who reported that dry matter yields of maize sown alone were greater than soybean intercropping. Moreover, Chellaiah and Ernest (1994) concluded that growing sorghum and maize in mixture with cowpeas and soybeans in 1:1 and 2:1 row proportions produced more fresh weight, dry weight and crude protein than their sole planting.

Clearly, data obtained from this experiment showed low green fodder yield and low dry matter yield for all sowing ratio treatments. This might be caused by bad soil and weather conditions and low quality of irrigation water (increasing soil and water salinity and increasing temperature during the experiment). Also, the experiment was almost started at the end of the growing season, causing weak and slow growth for both crops.

In general, alfalfa - Rhodes grass in mix fodder, may not be the best combination at low distances spacing (20cm between rows). However, both crops may be grown separately to obtain higher fodder production, perhaps under better condition. Furthermore, the two fodder crops or at least the varieties selected may not be best suited under Hada Al-Sham conditions. Nonetheless, the results of this experiment suggest the best ratio for fodder mixture as Rhodes grass alone (0:100), 25:75 and 50:50 ratios to attain higher fodder yield of good qualities.

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References

Al- Tahir, O. A., Al- Karouri, A. M. O., Bin Duheash, O.A. and **Abo- Rady, M.** (1989) *Final Report on Adaptation And Selection of Grain Legumes Under some Environmental Stresses in Saudi Arabia*, Research Project No. AR- 7- 193, College of Agricultural and Food Sciences and King Abdulaziz City for Science and Technology (KACST).

Chaudhary, M.H. and **Hussain, A.** (1985) A new high fodder yielding variety (P-518) of cowpea, *Pak. J. Agric. Res.,* **6**:267-270.

Chellaiah, N. and **Ernest, J. (**1994) Fodder production of cereal legume mixture. *Livestock-Adviser,* **19**:15-18.

Droushiotis, D.N. (1989) Mixtures of annual legumes and small-grained cereals for forage production under low rainfall, *J. Agric. Sci.,* **113**: 249-253.

Gilliland, T.J. and **Johnston, J.** (1992) Barley/pea mixture as cover crops for grass re-seeds. *Grass and Forage Sci.,* **47**(1):1-7.

Hong, K.S., Lee, H.J. and **Rhyu, J.H.** (1987) Response of maize and soybean canopy structure, dry matter and yield to intercropping, *Korean J. Crop Sci.,* **32**: 357-358.

Ibrahim M., Rafiq, M., Sultan, A., Akram, M. and **Goheer, M.A.** (2006) Green fodder yield and quality evaluation of maize and cowpea sown alone and in combination, *J. Agric. Res.,* **44**:15-22.

Karadau, Y. (2003) Effects of seed rates on forage production, seed yield and hay quality of annual legume - barley mixtures, *Turk J. Agric. For.,* **27**: 169-174.

Khandaker, Z.H. (1994) Effect of mixed cropping of maize *(Zea mays* L.) and cowpea *(Vigna unguiculata)* forage on fodder yield, chemical composition and its *in vitro* digestibility, *Indian J. Anim. Nutri*., **11**:55- 57.

Khot, R.B., Desale, J.S., Pisal, A.A. and **Patil, S.K. (**1992) Assessment of forage production potential of maize *(Zea mays)* with forage legumes in various planting system, *Indian J. Agron.,* **37**:343-345.

Kukten, K. and **Tansõ, V. (**1999) *Research on the Possibilities of Growing Chickling Mixtures with Different Cereals Species Under Cukurova Conditions*. III. Turkey Field Crops Congress. November 15-18, Adana, pp.207-212.

Janson, C.G. and **Knight, K.L. (**1973) Establishment of lucerne with cover crops under different soil moisture conditions, *J. Exp. Agric*., **1**: 243-251.

Lanini, W.T., Orlof, S.B., Vargas, R.N., Orr, J.P., Marble, V.L. and **Grattan, S.R**. (1991) Oat companion crop seeding rate effect on alfalfa establishment, yield and weed control. *Agron. J.,* **83**: 330-333.

Maurice, E.H., Robert, F.B. and **Darrel**, **S.M.** (1985) *Forages. The Science of Grassland Agriculture*, 4th ed. Iowa State University Press (Ames), Iowa, U.S.A.

Miller, D.A. and **Stritzke, J.F.** (1995) Forage establishment and weed management, In *Forages* Vol. I: *An Introduction to Grassland Agriculture*, (ed.) R.F. Barnes, D.A. Miller and C.J. Nelson, Iowa State Univ. Press, Ames, Iowa, pp. 89-104.

Mohapatra, B.K. and **Pradhan, L.** (1992) Intercropping fodder legumes with maize in different planting patterns, *Ann. Agric. Res*., **13**: 366- 371.

Moreira, N. (1989) The effect of seed rate and nitrogen fertilizer on the yield and nutritive value of oat-vetch mixtures, *J. Agric. Sci. Camb.,* **112**:57-66.

Osman, A.E. and **Nersoyan, N.** (1985) Annual legumes for integrating rain-fed crop and livestock production, *Proceedings. XVth International Grassland Congress,* **5**: 123-125.

Roberts, C.A., Moore, K.I. and **Johnson, K.D.** (1989) Forage quality and yield of wheat-vetch at different stages of maturity and vetch seeding rates, *Agron. J*., **81**: 57-60.

Rynolds, M.P., Sayre, K.D. and **Vivar, H.E.** (1982) Intercropping wheat and barley with N fixing legume species: A method for improving ground cover, N-use efficiency and productivity in low input systems, *J. Agric. Sci*., **123**: 175-183.

Steel, R.G.D. and **Torrie, J.H.** (2000), *Principles and Procedures of Statistics*, 3rd ed., McGraw-Hill, N.Y. USA.

Tan, M., Serin, Y. and **Erkovan, H. Ü. (**2004) Effects of barley as a companion crop on the hay yield and plant density of red clover and the botanical composition of hay, *Turk. J. Agric. For.,* **28**: 35-41.

Thomas, C.A., Srivastava, A. and **Vasudevan, K.** (1984) Mineral content of forage as influenced by varying proportion of jowar and cowpea, *Seeds and Farms,* **10**(5):41-46.

Toniolo, L., Sattin, M. and **Mosca, G.** (1987) Soybean-maize intercropping for forage, *Eurosoya*, **5**:73-78.

Tukel, T., Hasar, E. and **HatipoÛlu, R.** (1997) *Effect of Mixture Rates and Cutting Dates on the Forage Yield and Quality of Vetch Triticale Mixtures and Their Seed Yields Under Lowland Conditions of Ukurova,* XVIIIrd International Grassland Congress, June 8-19, Canada, pp. 25-26.

Van Keuren, R. W. and **Matches, A. G.** (1988) Pasture production and utilization, In: A. A. Hanson, D. K. Barnes, and R. R. Hill, Jr. (ed.) Alfalfa and alfalfa improvement, *Agronomy,* **29**: 515-538.

Willey, R.W. and **Osiru, D.S.O. (**1972) Studies on mixture of maize and beans *(Phaseolus vulgaris),* with particular reference to plant population, *J. Agric. Sci. Camb.*, **79**:517-529**.**

محصول وجودة مخاليط حشيشة الرودس والبرسيم العلفية تحت تأثير معدلات بذر مختلفة في منطقة مكة المكرمة

أحمد عبد الله باخشوين

قسم زراعة المناطق الجافة، كلية الأرصاد والبيئة وزراعة المناطق الجافة

جامعة الملك عبد العزيز، جدة- المملكة العربية السعودية

المستخلص. أجريت هذه الدراسة بمحطة الأبحاث الزراعية بهدى الشام التابعة لجامعة الملك عبد العزيز، بمنطقة مكة المكرمة، لدراسة تأثير معدلات بذر مختلفة للبرسيم مع حشيشة الرودس (١٠٠ :صفر، وصفر:١٠٠، و٥٠:٥٠، و٧٥:٢٥، و٢٥:٧٥ على التوالي) على إنتاجية وجودة العلف الأخضر. وتمت مقارنة الإنتاج والجودة لمحصولي البرسيم وحشيشة الرودس كلا على حدة أو في خليط. بالإضافة إلى ذلك، تم تقدير معدلات الخلط المناسبة للبرسيم وحشيشة الرودس تحت الظروف البيئية لمنطقة مكة المكرمة.

أظهرت النتائج أن عدد النباتات في السطر (٢متر) قد تأثرت بمعدلات البذر المختلفة للبرسيم وحشيشة الرودس. وكان ارتفاع النبات وعدد الأوراق والوزن الرطب للنبات الواحد أيضا قد تأثروا معنويا بواسطة معدلات البذر المختلفة. وأظهرت الأوزان الرطبة والجافة للأوراق اختلافات معنوية عالية فيما بين معدلات البذر المختلفة. حيث أعطى معدل البذر ١٠٠: صفر (برسيم: رودس) أعلى عدد نباتات (٢٣٨،٩ نبات/٢م سطر)، وأقل ارتفاع (٢٩،٠٠٣ سم)، وأعلى عدد للأوراق (٦٧،٢٧ ورقة/ نبات)، وأقل وزن رطب للنبات الواحد (٣,١٦جم/ نبات)، وأقل وزن رطب

للأوراق (١,٠٨جم). إضافة إلـــى ذلـــك، ســـجل معـــدل البـــذر صفر:١٠٠ (برسيم: رودس) أعلى ارتفاع للنبات الواحـــد (٨٧,٢٥ سم)، وأقل عدد للأوراق للنبات الواحـــد (٢٠,٨ ورقـــة/ نبـــات)، وأعلى وزن رطب للنبات الواحد (١٧,١٦ جم/ نبات)، وأعلى وزن رطب للأوراق (٥,٥ جم). سجل أعلى وزن محصول علف أخضر وجافة (١٦١٥,٩٤ كجم/ه) و (١٥٩,٨٩ كجم/ه) علـــى التـــوالي لمعدل البذر ١٠٠٪ رودس. وسجلت أقل نسبة مادة جافة للبرســـيم الذي زرع لوحده مع وجود اختلافات معنوية عالية فيما بينها وبين كل المعدلات الأخرى. و كانت نسب البروتين الخـــام، والألیـــاف، والرماد قد تأثرت بمعدلات البذر المختلفة. احتوى محصول علف البرسيم ١٠٠٪ على أعلى بروتين خام (١٧,١٧٪)، وكانت نـــسبة الرماد (١٠,٠٪)، في حين أنتجت أعلى محتوى ألياف خـــام مـــن الخلـــيط ٧٥٪ و ١٠٠٪ حشيـــشة الـــرودس بقـــيم (١٧,٩٩٪) و(١٧,٣٪) على التوالي.