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Performance of Middle-Eastern Alfalfa Ecotypes in the Southwestern USA Using Traditional and Contemporary Harvest Management Practices

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Abstract. Non-winterdormant alfalfa (*Medicago sativa* L.) from the Middle East regrows rapidly and produces high forage yield making it attractive for use in warm-desert regions. In the Middle East, alfalfa is commonly harvested before flowering (bud stage) leaving less than 2 cm stubble. Alfalfa from this region has unique adaptations to this management and regrow predominately from meristems originating near the stem base. Harvest management may influence productivity of Middle-Eastern alfalfas in mechanized agriculture where late harvest and cutting heights between 8 and 12 cm predominate. We compared yield, persistence, and crown architecture of six Middle-Eastern alfalfa ecotypes under traditional (preflowering + 2 cm stubble) and contemporary harvest management (10% bloom + 10 cm stubble), and a combined regime (preflowering + 10 cm stubble) in a 27-month trial in Arizona. Contemporary harvest management resulted in significantly higher forage yield in the Middle-Eastern accessions than in either of the other regimes and did not disturb the initiation of regrowth stems. Forage yields of the most productive Middle-Eastern ecotype were 11 to 20% higher than an elite southwestern cultivar regardless of harvest regime. The combined regime, with its higher forage quality, may be preferred as Middle-Eastern alfalfas are utilized in mechanized agriculture.

Introduction

A number of non-winter dormant alfalfa ecotypes have evolved in desert areas of the Middle East [1, 2]. Today most alfalfa cultivars grown in warm desert regions worldwide descend from relatively few Middle Eastern introductions; primarily populations introduced to the USA from the Middle East before 1960 [3, pp 25-91]. Current research suggests that recently introduced ecotypes from the Middle East may be especially productive in the southwestern USA, a region that is climatically very similar to desert farming regions in the Middle East.

Desert-adapted alfalfas from the Middle East are unique in their ability to regrow rapidly following harvest and to remain productive during late fall, winter and early spring [4]. These ecotypes evolved under relatively warm winter conditions with frequent hand harvest very close to the soil surface [5, 6]. In order to persist under this management, a high proportion of stems are initiated from basal meristems on the crown close to the soil surface [7]. This management regime may be associated with the high productivity observed in these ecotypes. In a 12-month trial at Al-Hassa Oasis in Saudi Arabia, Al-Noaim *et al.* [5] observed that forage yield and stand density were significantly higher in the ecotype Hasawi when cut 2 cm above the ground relative to harvest leaving 8 cm stubble. This suggests that yield advantages of Middle-Eastern ecotypes may be diminished by harvest 8 to 12 cm above the ground surface, as is customarily applied in mechanized agriculture [8, pp. 567-594].

Regrowth may also be initiated at an earlier stage of maturity in Middle-Eastern ecotypes than in improved nondormant cultivars [7]. Harvest of Middle-Eastern ecotypes at later maturity stages, as is common in mechanized agriculture (typically when 10% of plants in bloom), may therefore result in removal of a large portion of young regrowing stems as well as the older first-regrowth stems. Such delayed harvest could reduce total forage yield since regrowth of basal stems that began precociously could be eliminated by harvest. Additional stems would need to elongate from different basal meristems which could reduce rates of regrowth of the primary stem class. Persistence and forage quality could also be affected by delayed harvest since extra nonstructural carbohydrates may be expended for the growth of additional calsses of basal stems with each harvest and more mature forage would have lower digestibility [9]. The unique regrowth characteristics of Middle-Eastern alfalfas suggest that changes in crop management may be necessary in mechanized agriculture to achieve optimum productivity with these ecotypes or new cultivars descending from them.

The objective of this experiment was to evaluate the effects of three harvest management regimes on forage yield and persistence of six Middle-Eastern alfalfa ecotypes and an elite cultivar at Tucson, AZ. Also, the effect of cutting height was evaluated on crown architecture and regrowth rate to study the relationships between these variables and forage yield and persistence. Comparisons of forage yield and persistence were made between plots harvested either: 1) at ground level (2 cm) before flowering "traditional Middle-Eastern harvest management", 2) 10 cm above the ground at early flowering "contemporary Southwestern harvest management", or 3) 10 cm above the ground before flowering "a possible combined regime".

Materials and Methods

Six Middle-Eastern ecotypes and the non-winter dormant cultivar Lew were included in this experiment, which was conducted at Tucson, AZ (alt. 790 m). Middle-Eastern ecotypes were selected based on their productivity in previous trials in

Arizona or because they exhibited extremely precocious regrowth from basal meristems [7]. The ecotypes and their country of origin were: 'Ed-Damer' (Sudan); 'Hasawi' and Hejazi' (Saudi Arabia); 'Egyptian IV' (Egypt via Saudi Arabia); 'Iraqi' (Iraq via Saudi Arabia), and 'Oman-11' (Oman) [2]. Iraqi is slightly more winter dormant than the other six entries, which show very little reduction in growth during winter in southern Arizona [2]. Fifty seeds of each entry were sown in September 1988 in 1-m single row plots spaced 0.75 m apart in a split-plot design with 4 replicates. Harvest management regimes were assigned to the main plots and populations to the sub-plots. Plots were thinned to 12 plants before the first harvest. The trial was flood irrigated every 7 to 14 days as necessary and no attempts were made to control insects.

Three harvest management regimes were imposed beginning in March 1989; 1) preflowering (all plants in the bud stage) leaving < 2 cm stubble, 2) early flowering (10% of plants showing bloom) leaving 10 cm stubble, and 3) preflowering with 10 cm stubble. Individual plants from the entrie plot were cut by hand and forage fresh weight and number of plants recorded in each plot. Initial growth of seedlings was harvested, using the appropriate regime, 150 d. after sowing without weighing. Data were available for 27-month period that included 19 harvests in Regime 2, and 21 harvests in both Regime 1 and 3.

To measure the effects of cutting height on crown architecture and regrowth rate, the number of stems and their height were recorded for plants included in Regimes 1 and 3 during eitht regrowth cycles in 1989. Seven days after harvest in early-March, three plants were randomly sampled and marked in each plot harvested. Every seven days for four weeks, all stems longer than 10 cm were counted and the length of the longest three stems recorded for each plant. Similar measurements were made every 7 d for the next seven 21-d regrowth periods (from late April until late September). Average stem length in the first week of regrowth and at harvest were used to calculate stem elongation rate as mm day^{-1}. Data were statistically analyzed using the Statistical Analysis System, version 6.03 [10].

Results and Discussion

Considering the Middle-Eastern accessions together, contemporary southwestern harvest management (10 cm cuting height at 10% bloom) resulted in significantly higher forage yield than either of the other harvest regimes (Table 1). None of the individual Middle-Eastern accessions yielded significantly more forage when harvested at 2 or 10 cm before flowering (Regime 1 and 3) compared to contemporary harvest management (Regime 2). Survival of Middle-Eastern accessions was, also, significantly lower with harvest at 2 cm (60.1%) as compared to both 10-cm (77.1 and 75.1%) harvest regimes (Table 1). The yield disadvantage of the traditional harvest management (2 cm cutting height at preflowering) may be due to lack of additional

stems initiated from acillary meristems on stubble. Stubble were not allowed to develop in the traditional harvest regime, and stems were predominately initiated on the fleshy part of the primary crown less than 2 cm from the soil surface. In the 10-cm harvest regimes, stems could be initiated either at the crown, from axillary meristems on individual branches that had grown from the fleshy crown remaining after harvest or from both [11].

Table 1. Mean % survival and forage yield per plant and plot (± s.e.) for six Middle-Eastern Alfalfa ecotypes and the cultivar Lew over a 27-month period under three harvest management regimes in southern Arizona.

Harvest regime		Population	% survival	g plant^{-1}a	Kg plot^{-1}b
Preflowering	2cm	All M-E accessions	60.1 B[c]	111.1 B	18.9c
stubble		Ed-Damer	74.6±7.8	132.4±3.7	22.3±0.9
		Egyptian IV	68.5±3.4	112.1±5.3	23.1±1.5
		Hasawi	67.2±5.3	97.1±8.2	17.7±2.4
		Hejazi	61.5±5.7	127.0±15.3	21.3±2.4
		Iraqi	23.7±18.9	103.5±21.1	13.2±3.9
		Omani 11	68.3±3.2	101.8±5.4	16.8±1.7
		Lew	66.3±7.7	116.9±11.8	19.2±1.8
LSD			12.0	22.5	2.3
Preflowering	10 cm	All M-E accessions	77.1 A	122.7 B	21.4 B
stubble		Ed-Damer	85.4±4.3	133.0±9.8	24.8±1.6
		Egyptian IV	89.1±9.4	134.7±12.2	23.2±0.6
		Hasawi	60.9±15.7	99.2±5.0	17.6±1.2
		Hejazi	73.0±13.7	133.6±12.9	24.5±2.1
		Iraqi	81.1±10.6	128.4±25.2	19.3±1.1
		Omani 11	72.6±10.4	107.3±4.5	18.9±0.2
		Lew	85.9±8.8	129.7±9.0	22.3±2.7
LSD			14.4	22.3	2.1
10 % flowering	10 cm	All M-E accessions	75.1 A	186.1 A	24.7 A
stubble		Ed-Damer	83.6±2.1	222.6±13.7	29.0±1.5
		Egyptian IV	79.6±4.2	197.6±19.6	27.0±2.2
		Hasawi	57.9±10.4	168.7±13.9	20.9±2.3
		Hejazi	86.7±4.5	226.0±9.0	29.5±1.5
		Iraqi	68.2±10.1	179.5±18.0	22.8±2.1
		Omani 11	74.2±6.9	122.1±12.4	18.8±1.9
		Lew	77.1±4.9	240.1±15.7	25.8±0.9
LSD			13.9	29.0	2.6

a Mean fresh weight per harvest; b Total fresh weight over all harvests; c Means for all Middle-Eastern accessions within a column that are follwed by the same letter not significantly different ($P \leq 0.05$) by LSD test.

There was a considerable variation in performance among the Middle-Eastern accessions under each harvest management regime (Table 1). The relative performance of individual accessions was consistent across harvest regimes and there was no significant difference ($P \leq 0.05$) in accession X harvest regime interaction for survival or forage yield. Rank correlation for total forage yield in the Middle-Eastern entries between the three harvest regimes ranged from $r_s = 0.66$ to 0.88 ($P \leq 0.16$-0.01, n=6), with no rank shift greater than two places observed for an accession between any pair of regimes. Certain accessions appeared especially well adapted to the Arizona environment regardless of harvest regime. For example, under the contemporary harvest regime, Ed-Damer produced a total yield that was 12.4% higher than that of Lew. In addition, under the regimes with preflowering harvest, which would likely result in forage of a higher nutritional quality [9], Ed-Damer produced an average of 16.2 and 11.2% more forage than Lew with 2 and 10 cm harvest, respectively. Survival of Ed-Damer did not differ significantly from that of Lew under any harvest regime (Table 1).

For the six Middle-Eastern ecotypes considered individually or as a group, preflowering harvest at 2 and 10 cm did not result in significant differences in two of the primary components of forage yield: mean stem number and rate of stem elongation (Table 2). However, plant height was significantly greater in the Middle Eastern ecotypes with harvest at 10 cm than at 2 cm. These differences in plant height could be the result of stem initiation on axillary meristems elevated on the remaining stubble, since mean stem elongation rates were not significantly different in these accessions in the two regimes. This also indicates that, at least, a portion of the stems produced by Middle-Eastern ecotypes were from axillary meristems on stubble and not only from basal meristems on crown. The ability to generate growth from basal and axillary meristems may be important in maintaining the high productivity in non winter-dormant alfalfas with frequent harvest.

Regrowth characteristics of the Middle Eastern ecotypes were generally higher than those for Lew (Table 2). Stem elongation rates were significantly greater in both harvest regimes in the Middle-Eastern ecotypes (30.3 and 38.6) than in Lew (20.7 and 30.5) in the first 7 d following harvest. Maximum plant height was also significantly greater in the Middle-Eastern accessions (Table 2). In addition, significantly fewer stems (−44.5%) were also produced by plants from Lew when harvested at 2 cm than at 10 cm (Table 2). However, harvest at 2 cm has resulted only in 10.9% reduction in single-plant yield in Lew which indicates that Lew might have higher stem weight than the Middle Eastern ecotypes (Table 1). This supports the yield data and indicates that a generally higher proportion of stems are initiated on the fleshy part of the primary crown in the Middle-Eastern alfalfas than in the elite U.S. cultivar Lew. These findings also show that long-term preflowering harvest at 10 cm does not disturb the initiation of regrowing stems in the Middle-Eastern alfalfas.

Table 2. Mean (± s.e.) sstem number and plant height at harvest, and stem elongation rate for six Middle-Eastern alfalfa ecotypes and the cultivar Lew over eight harvest -regrowth cycles (April-Sept.) with harvest at 2 cm or 10 cm at the bud stage

Harvest regime	Population	Stem number	Plant height	Stem elongation rate[a] 1-7 d post harvest	Stem elongation rate[a] 1-21/28 d post harvest
				---------- mm day^{-1} ----------	
Preflowering	**All M-E accessions**	**24.3 A**	**55.2 B**	**30.3 B**	**26.2 A**
2 cm stubble					
	Ed-Damer	**28.7**±4.5	55.6±1.8	32.6±1.4	26.2±0.9
	Egyptian IV	30.9±3.9	65.1±0.9	37.7±0.8	30.6±0.4
	Hasawi	14.2±1.2	45.1±4.0	23.1±2.5	22.5±1.5
	Hejazi	26.2±2.2	61.6±2.0	32.9±1.2	28.9±0.9
	Iraqi	20.4±4.5	42.8±4.7	20.9±2.3	20.1±2.3
	Omani 11	24.9±4.0	61.1±1.6	34.4±1.2	28.8±0.8
	Lew	18.3±3.6	47.6±4.4	20.7±2.5	22.2±2.0
LSD		6.4	6.1	4.5	2.8
Preflowering	All M-E accessions	26.5 A	61.2 A	38.6 A	28.8 A
10 cm stubble	ED-Damer	30.0±4.7	62.6±3.8	45.6±3.0	39.5±1.8
	Egyptian IV	29.4±3.6	69.4±1.6	41.1±1.5	32.6±0.7
	Hasawi	21.7±3.7	54.2±3.3	30.5±2.6	25.4±1.6
	Hejazi	33.3±2.1	66.3±1.9	48.3±1.0	31.2±0.9
	Iraqi	24.7±4.0	56.4±3.5	31.3±2.4	26.5±1.7
	Omani 11	19.9±1.9	58.3±1.4	34.7±1.7	27.7±0.7
	Lew	32.8±4.0	51.5±5.9	30.5±2.6	25.7±2.6
LSD		7.7	7.5	5.4	3.4

a Stem elongation rate = (change in mean plant height in 7 days)/7.

b Means for all Middle-Eastern accessions within a column followed by the same letter are not significantly different ($P \leq 0.05$) by LSD test.

Analysis of individual components of total forage yield (Table 1), crown architecture, and regrowth rate (Table 2) indicate that the overall yield disadvantage of the traditional harvest regime for the Middle-Eastern accessions was likely due to the combined effects of reduced persistence (–24.9%) and yield per plant (– 67.5%). Removal of any precociously regrowing stems, which occurred regularly with harvest at 10% bloom, was not associated with decreased forage yield or persistence in Middle-Eastern entries, however. Indeed the production and harvest of multiple classes

of generally longer stems may represent the basis of higher forage yields for Middle-Eastern accessions under contemporary harvest management.

Reduced persistence and forage yield with traditional harvest management may either be the result of insufficient replenishment of nonstructural carbohydrates in the root and crown due to repeated premature harvest at 2 cm [11], or due to the absence of significant residual stem tissue (stubble) for the initiation of regrowth [12-14]. Correlation data among yield components support the assertion that the level of nonstructural carbohydrates, which are ultimately a function of the amount of forage produced under a single management regime [15], may be associated with the significantly lower survival of the Middle-Eastern accessions with harvest at 2 cm under Arizona conditions. Percent survival was strongly and positively correlated with the total forage yield ($r=0.73$, $P\leq0.01$), plant height ($r=0.59$, $P\leq0.05$) and mean stem elongation rate (1-21/28 d post-harvest, ($r=0.63$, $P\leq0.01$) in the Middle-Eastern accessions with harvest at 2 cm. However, survival was less closely associated with these variables with harvest at 10cm (total forage yield: $r=0.44$, $P\leq0.05$; plant height: $r=0.29$; stem elongation rate: $r=0.28$). The bulk of the yield advantage of contemporary harvest management over the combined regime was apparently due to increased yield per plant (51.6%), as a result of higher stem weights that accumulated during the prolonged regrowth period, and not due to differences in survival.

While most productive Middle-Eastern alfalfas appeared better adapted to the traditional harvest regime under Arizona conditions than Lew, the highest productivity was obtained with the contemporary harvest management. These results may appear to contradict the most comparable previous study where Al-Noaim *et al.* [5] found that forage yield and plant population of the Middle-Eastern ecotype Hasawi were 21 and 52% higher, respectively, with harvest at 2 and at 8 cm after one year of harvest in Saudi Arabia. No significant differences in survival or forage yield were observed among the three harvest regimes for Hasawi in this study (Table 1). However, the mean stem number was considerably lower for Hasawi under both cutting regimes (–41.6% at 2 cm; - 18.1% at 10 cm) than for the mean of all other Middle Eastern ecotypes. Stem elongation rate was similarly lower in Hasawi than the average for the other Middle-Eastern ecotypes (–11.5% at 2 cm; –25.0% at 10 cm). This provides some evidence that Hasawi may not generally be well adapted to the southern Arizona conditions which may explain its poor performance under traditional harvest management. Schaffer *et al.* [16, pp 411-437], summarizing previous research with alfalfa, reported that if harvest regimes do not deplete nonstructural carbohydrates, highest herbage yields would be obtained with shorter cutting heights, although cutting heights less than 5 cm or repeated cutting intervals less than 28 d were not considered . In this study, the highest forage yields in all accessions were obtained with conventional harvest at 10% bloom.

Certain well-adapted Middle Eastern ecotypes (Ed-Damer, Hejazi) had a significant yield advantage over Lew under both conventional and traditional harvest man-

agement. Regrowth data collected with preflowering harvest suggest that high rates of stem elongation may explain the yield advantage of these accessions. Ed-Damer and Hejazi had stem elongation rates in the first week after harvest that were 57 and 58%, respectively, greater than that of Lew. A similar differential in stem elongation rate was maintained for the entire growth cycle for these accessions. Yields of these Middle Eastern accessions also did differ from Lew with preflowering harvest at 10 cm. This suggests that the combined harvest regime, with its expected higher forage quality, may be preferred as these ecotypes are utilized in mechanized agriculture in warm-desert regions of the world.

References

[1] Guarino, L. "Alfalfa Collecting in Southern Arabia." *Plant Genetic Resources Newsletter,* 80 (1992), 33-35.

[2] Smith, S.E.; Al-Doss, A.; and Warburton, M. "Morphological and Agronomic Variation in North African and Arabian alfalfas". *Crop Sci.,* 31 (1991), 1159-1162.

[3] Michaud, R.; Lehman, W.F., and Rumbaugh, M.D. "World Distribution and Historical Development." In: *Alfalfa and Alfalfa Improvement.* A.A. Hanson; D.K. Barnes; and R.R. Hill, JR. (Eds.) Madison, WI: American Society of Agronomy, 1988,

[4] Marble, V.; Wilton, A.C.; and Cook, A.A. "Performance of Nine Mid-East Alfalfa Ecotypes and Seventeen Introduced Cultivars in Saudi Arabia." *Proceedings of the XV International Grassland s Congress.* Tokyo, Japan, 1 (1985), 129-131.

[5] Al-Noaim, A.A.; Davies, G.M.; and Farnworth, J. "A Study of Hasawi Alfalfa under Three Irrigation and Three Cutting Regimes in Saudi Arabia." *Experimental Agriculture,* 14 (1978), 57-63.

[6] Marble, V.L. "Fodder for the Near East: Alfalfa". FAO Plant Prod. Prot. Paper 97/1, Rome: FAO 1989.

[7] Al-Doss, A. and Smith, S.E. "The Potential Use of Middle Eastern Alfalfas for Increased Yield in Winter and Spring." *Agronomy Abstracts,* (1989), 72.

[8] Pauli, A.W.; Lechtenberg, V.L., and Wedin, W.F. "Equipment for Harvesting Transporting, Storing and Feeding." In: *Alfalfa and Alfalfa Improvement.* A.A. Hanson; D.K. Barnes, and R.R. Hill, JR. (Eds.), Madison, WI: American Society of Agronomy, 1988.

[9] Weir, W.C.; Jones, L.G., and Meyer, J.H. "Effect of Cutting Interval and Stage of Maturity on the Digestibility and Yield of Alfalfa." *J. Animal Sci.,* 19 (1960), 5-19.

[10] SAS Institute. *SAS/STAT user's Guide.* Release 6.03 ed., NC: SAS Inst., Cary 1988.

[11] Robison, G.D. and Massengale, M.A. "Effect of Harvest Management and Temperature on Forage Yield, Root Carbohydrates, Plant Density and Leaf Area Relationships in Alfalfa (*Medicago sativa* L.) Cultivar 'Moapa.'" *Crop Sci.,* 8 (1968), 147-151.

[12] Smith, D. and Nelson, C.J. "Growth of Birdsfoot Trefoil and Alfalfa. I. Responses to Height and Frequency of Cuttings." *Crop Sci.,* 7 (1967), 130-133.

[13] Volenec, J.J. "Herbage Growth and Carbohydrate Metabolism of Diploid and Tetraploid Alfalfa." *Crop Sci.,* 28 (1988), 128-132.

[14] Hendershot, K.L. and Volenec, J.J. "Shoot Growth, Dark Respiration, and Nonstructural Carbohydrates of Contrasting Alfalfa Genotypes." *Crop Sci.,* 29 (1989), 1271-1275.

[15] Smith, D. "Carbohydrate Root Reserves in Alfalfa, Red Clover, and Birdsfoot Trefoil Under Several Management Schedules." *Crop Sci.,* 2 (1962) 75-78.

[16] Schaffer, C.C.; Lacefield, G.D.; and Marble, V.L. "Cutting Schedules and Stand." In: *Alfalfa and Alfalfa Improvement.* A.A. Hanson; D.K. Barnes, and R.R. Hill, JR. (Eds.) Madison, WI: American Society of Agronomy, 1988.

دراسة إنتاجية سلالات البرسيم الحجازي للشرق الأوسط في جنوب غرب الولايات المتحدة الأمريكية تحت ظروف الطرق التقليدية والحديثة لحصاد البرسيم الحجازي

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ملخص البحث. تنمو سلالات البرسيم الحجازي غير الكامنة شتاءً والناشئة في المناطق الدافئة في الشرق الأوسط سريعًا بعد الحصاد وتعطي محصولاً عاليًا للعلف مما يجعلها مرغوبة للاستخدام في المناطق المشابهة في العالم مثل جنوب غرب الولايات المتحدة الأمريكية. ولكن هذه السلالات نشأت تحت ظروف حصاد تقليدية تعتمد على قطع المحصول مبكرًا قبل الإزهار وعلى ارتفاع قريب من سطح التربة وتأقلمت عن طريق إنتاج نسبة أكبر من المحصول من براعم التاج قرب سطح التربة وليس من البراعم الإبطية الموجودة على قواعد سيقان المحصول السابق كما هو الحال في معظم الأصناف الأمريكية. تلك السلالات قد لا تتأقلم مع الطريقة المتبعة في الزراعة الآلية الحديثة من تأخير موعد الحصاد إلى بعد الإزهار وقطع المحصول على ارتفاع بين ٨ ـ ١٢ سم.

في هذه الدراسة تمت مقارنة ست سلالات من البرسيم الحجازي للشرق الأوسط وكذلك دراسة تأثير طريقة وموعد الحش على إنتاج وديمومة هذه السلالات. استخدمت ثلاث معاملات للحصاد، الأولى وهي الطريقة التقليدية في الشرق الأوسط (حصاد مبكر على ارتفاع ٢ سم)، والثانية الطريقة الحديثة (١٠٪ أزهار على ارتفاع ١٠ سم) والطريقة الثالثة هي دمج للطريقتين حيث تم حصاد البرسيم مبكرًا على ارتفاع ١٠ سم.

وقد بينت النتائج أن الطريقة الحديثة أعطت أعلى إنتاج للعلف الأخضر ولم تؤثر على النموات الجديدة وكان إنتاج أفضل سلالات الشرق الأوسط أعلى من الصنف الأمريكي بمعدل يتراوح بين ١١ ـ ٢٠٪ في جميع المعاملات. كما بينت النتائج أن طريقة الحصاد المبكر على ارتفاع ١٠ سم قد تكون الطريقة المثلى لإدارة هذه الأصناف نظرًا لارتفاع الإنتاج من العلف الأخضر ولجودة نوعية البرسيم في هذه الحالة بخلاف المتبع في طريقة الزراعة الآلية الحديثة.