

# Agronomic performance of seven varieties of alfalfa (*Medicago sativa* L.) in the coastal savanna zone of Ghana

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## SUMMARY

Seven varieties of alfalfa, namely Iroquois, Vernal, Mohawk, Pike F0185, WL 318, Oneda and WL 514, were screened for agronomic performance at Cape Coast in the coastal savanna ecological zone of Ghana during the period from May 1992 to May 1993. A total of 10 harvests were taken at monthly intervals after 3 months of initial growth. Significant differences ( $P < 0.01$ ) were established among the varieties for dry matter yield, leaf-stem-ratio, rate of regrowth after cutting, and flowering ability. Total dry matter yields for the 10 cuts ranged from 21 049 kg/ha for Mohawk to 24 171 kg/ha for WL 318. Dry matter yield at each cut varied considerably over the year. The highest yields of 3 100 to 3 700 kg/ha/cut were obtained during the second cut in October and the least yields of 1490 to 1650 kg/ha were obtained during the sixth cut taken in January. When left to overgrow, percentage of plants that flowered ranged from 11.3 for Mohawk to 67.5 for WL 318. Again two types of insects, honey bees and the blow fly *Calliphora* spp., were observed to effectively trip the flowers.

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## Introduction

Over the years, stockmen in Ghana have relied on natural grassland as the only source of feed for their livestock. There are problems associated with this practice. The natural grasslands are deficient in legume species and they also become quickly lignified with age. Consequently, they are not of high nutritive value for effective production (Rose-Innes & Clayton, 1977; Amaning-Kwarteng, 1989).

## RÉSUMÉ

TETTEH, J. P. & BONSU, K. O.: *La performance agronomique de sept variétés de la luzerne (Medicago sativa L.) dans la zone savanno-côtière du Ghana.* Sept variétés de la luzerne, à savoir Iroquois, Vernal, Mohawk, Pike F 0185, WL 318, Oneda et WL 514, étaient passées au crible pour la performance agronomique à Cape Coast dans la zone écologique savanno-côtière du Ghana au cours de la période de Mai 1992 à Mai 1993. Une totalité de 10 récoltes étaient prises aux intervalles mensuels après 3 mois de la croissance initiale. Des différences considérables ( $P < 0.01$ ) étaient établies parmi les variétés pour le rendement de la matière sèche, la proportion-feuille-tige, la proportion de recroissance après le découpage et la capacité de floraison. La totalité de rendements pour les 10 coupures varie entre 21 049 kg/ha pour Mohawk et 24 171 kg/ha pour WL 318. Le rendement de la matière sèche à chaque coupure variait considérablement sur une période de l'année. Les rendements plus élevés de 3 100 à 3 700 kg/ha/coupeure étaient obtenus pendant la 2<sup>ème</sup> coupeure en Octobre et les moindres rendements de 1490 à 1650 kg/ha étaient obtenus pendant la 6<sup>ème</sup> coupeure prise en Janvier. Quand on laisse à trop grandir le pourcentage de plantes qui fleurissait, varie entre 11.3 pour Mohawk et 67.5 pour WL 318. Encore deux espèces d'insectes, les abeilles et la mouche à viande *Calliphora* spp. étaient observées de faire trébucher les fleurs efficacement.

The grass is abundant during the rainy season but scarce during the dry season. Animals, therefore, lose weight during the dry season. Due to this seasonal fluctuation in body weight, animals take longer time than necessary to reach reproductive age or slaughter weight (Rose-Innes & Clayton, 1977; Amaning-Kwarteng, 1989).

A way to stop this fluctuation in productivity will be to provide adequate quality feed during the

dry season. One pasture crop with a potential to shave off the dry season weight loss of animals is alfalfa. Though yields and nutritive value are reported to be high under temperate conditions, there are some varieties reported to do well under high temperature conditions of up to 49 °C (Martin, Leonard & Stamp, 1967), or even 64 °C (Kumar *et al.*, 1967).

This work was undertaken to assess the prospects of growing alfalfa as a forage crop in Ghana.

### Materials and methods

The experiment was carried out at the University of Cape Coast Research Farm, on a site which was cropped with yam over the 2 years prior to the experiment. The physical and chemical characteristics of the soil are as follows: 79 per cent sand, 10.4 per cent silt, 7.8 per cent clay, 0.13 per cent nitrogen, 1.62 per cent organic carbon, and a mean pH of 7.1. The land was ploughed, then well decomposed farm yard manure was spread at the rate of 1.7 t/ha and harrowed into the soil.

The randomized complete block design was used. Treatments consisted of seven varieties of alfalfa, Iroquois, Oneda, and Mohawk from USA, Vernal from Canada, Pike F0185 from Puerto Rico, WL 318 and WL 514 from Ethiopia (ILCA). Each treatment was replicated four times. A plot consisted of six rows spaced 25 cm apart and 4 m long. Seeds were dressed with a fungicide, Dithane M45, before sowing. Seeds were hand-drilled at a rate of 20 kg/ha on 29 May 92. Two weeks after sowing, seedlings were inoculated with a mixture of four strains of *Rhizobium meliloti*. The strains were HAMB1 470 (Mel2) from Finland, HAMB1 504 (102 F 73) from USA, HAMB1 1150 (N.Z.P., 4010) from Uruguay, and HAMB1 1167 from Canada. Each strain was cultured on an agar plate in a petri dish. Samples from each culture plate were taken together and blended in a litre of water to form a suspension. The resulting suspension was further diluted and sprayed onto the seedlings by using a knapsack sprayer. The field was immediately irrigated by using a sprinkler irrigation to wash down the rhizobia into the soil.

Weeds were controlled by hoeing twice at 12 and 42 days after sowing. A total of 10 harvests were taken. The first harvest was taken on 4 Sep 92, when plants were 3 months old. At that time, the early flowering varieties were at the 10 per cent flowering stage. Subsequent harvests were done at 4 weeks intervals. Harvesting was done manually by cutting the plants in the middle four rows of each plot at about 5 cm above the ground. Data was collected on the following parameters:

1. Fresh weight and dry weight per plot at each harvest.
2. Rate of regrowth after cutting.
3. Leaf-stem-ratio.
4. Percentage flowering.

The rate of regrowth was determined by tagging four plant per plot after the second harvest, and measuring their height at weekly intervals until the next harvest was done. Observations were also made on competitiveness with weeds, nodulation and incidence of pests and diseases. Percentage flowering and ability of plants to set seed naturally were determined by leaving border plants of each plot to overgrow after the third harvest. These border plants were observed for flowering and seed setting. Insects were also observed for their ability to trip flowers to effect pollination.

### Results and discussion

#### *Crop establishment*

Seeds germinated within 48 h after sowing. Initial growth of seedlings was extremely slow such that they were quickly overtaken by weed seedlings which sprouted later. This necessitated an early weed control (12 days after sowing). The first weeding by hoeing was very tedious because the alfalfa seedlings were very tiny and difficult to differentiate from the weeds. Drilling in rows was of some help because it made it easier to control the weeds in the inter-row spaces. Nevertheless, a more appropriate way of reducing the initial weed competition at the early seedling stage need to be sought if large-scale cultivation of the crop is to be undertaken.

After the first weeding, the alfalfa plants grew

quite vigorously, and were able to effectively compete with the weeds. The second weeding became necessary mainly to minimize contamination of the first harvest with weeds.

#### *Insects observed on alfalfa*

A total of 16 different types of insects were observed on the alfalfa crop, some of which were identified as helmet bugs (*Coptosoma* spp.), black helmet bugs (*Brachylatys testudonigra*), blowflies (*Calliphora* spp.), honeybees (*Apis mellifera*), grasshopper (*Zonocerus variegatus*), leaf bean beetle (*Oothea bennigseni*), termites, spring canker worm (*Paleacrita vernata*), Cape mounted rifle beetle (*Mylabris* spp.) and beetle (*Asbestea cyanipennis*). Termite activity was high during the dry season. They chewed the crown, and sometimes roots of plants. This, coupled with the frequent cutting of plants, led to the death of some plants.

The honeybees and the blowflies were observed to be actively involved with tripping of the flowers to effect pollination.

Besides the insects, a few spiders which served as predators on the insects, were also observed on the crop. Despite the numerous types of insects observed, damage to the crop was insignificant.

#### *Rate of regrowth after cutting*

The rate of regrowth after cutting was fairly high, ranging from 2.18 cm/day for Vernal to 2.93 cm/day for WL 318 (Table 1). This confirms an observation by Allen & Allen (1981) that alfalfa has a high rate of recovery after cutting, and consequently is able to provide greater flexibility for the livestock owner than many other forage legumes. There was again a highly significant positive correlation ( $r=0.62^{**}$ ) between rate of regrowth and dry matter yield. The high rate of regrowth also made it possible for frequent harvests to be taken. Consequently, 10 harvests at 4-week intervals were achieved within one year of the experimental period. The rapid rate of regrowth also enabled the alfalfa to effectively compete with and hence smother the weeds in the field.

TABLE 1

*Dry Matter Yield, Leaf-Stem Ratio (LSR), Rate of Regrowth (ROR) and Percentage Flowering for Seven Varieties of Alfalfa*

Variety	DM yield (kg/ha)	LSR	ROR (cm/day)	Percentage flowering
WL 318	24,171 <sup>a</sup>	1.62 <sup>ab</sup>	2.93 <sup>a</sup>	67.50 <sup>a</sup>
Vernal	22,939 <sup>ab</sup>	1.58 <sup>ab</sup>	2.18 <sup>b</sup>	32.50 <sup>b</sup>
WL 514	22,431 <sup>ab</sup>	1.65 <sup>ab</sup>	2.65 <sup>ab</sup>	31.50 <sup>b</sup>
Pike FO185	21,955 <sup>b</sup>	1.52 <sup>b</sup>	2.37 <sup>b</sup>	18.75 <sup>bc</sup>
Iroquois	21,841 <sup>b</sup>	1.52 <sup>b</sup>	2.38 <sup>b</sup>	20.00 <sup>b</sup>
Oneda	21,102 <sup>b</sup>	1.50 <sup>b</sup>	2.45 <sup>ab</sup>	22.50 <sup>bc</sup>
Mohawk	21,049 <sup>b</sup>	1.76 <sup>a</sup>	2.31 <sup>b</sup>	11.25 <sup>c</sup>
Mean	22,210	1.59	2.45	29.04
CV %	2.08	3.21	45.98	15.26
SE	484.60	0.05	0.12	4.43

Means within a column followed by the same letter are not significantly different at  $P=0.01$ . (Duncan's Multiple Range Test).

#### *Leaf-stem ratio*

Significant differences ( $P<0.01$ ) were observed among the varieties for leaf-stem ratio. It ranged from 1.50 for Oneda to 1.76 for Mohawk. Alfalfa leaves have higher concentration of nutrients and are better digested than stems (Luckett & Klopfenstein, 1970). Consequently, varieties with higher leaf-stem ratio (LSR) are expected to be of higher nutritive value than those with lower LSR. Thus, whereas Mohawk may be expected to have highest nutritive value, it unfortunately had the lowest dry matter (DM) yield. It would be appropriate to select varieties on the basis of digestible DM yield, rather than on DM yield or LSR alone.

#### *Dry matter yield*

Total dry matter (DM) yields for the 10 cuts put together for each variety were very high, ranging from 21,049 kg/ha for Mohawk to 24,171 kg/ha for WL 318. These yield values compared favourably with those obtained in other tropical countries, such as 15.4 to 28.6 t/ha for 10 cuts in Puerto Rico (Anonymous, 1988). Yields were, however, lower than those obtained from 17 cuts under irrigated

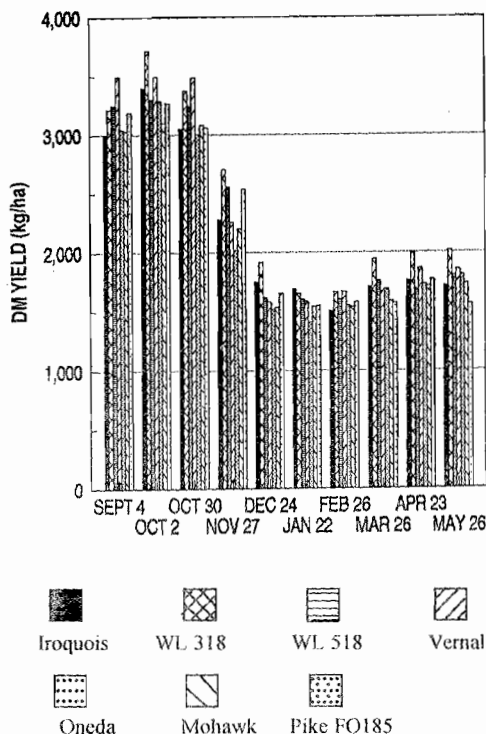


Fig. 1. Variability of dry matter (DM) yield of alfalfa varieties harvested at various times.

conditions in Saudi Arabia which ranged from 36.9 to 54.7 t/ha (Marble, 1989).

Yields also varied considerably from one cut to another during the year. Very high yields in excess of 3000 kg/ha per cut were obtained for the first three cuts. Thereafter, yields declined to between 1,500 to 1,800 kg/ha per cut for the fifth - tenth cuts (Fig. 1). The first three cuts were taken during the minor rainy season when there was fairly adequate moisture for rapid regrowth to occur. The fifth to eighth cuts were taken during the dry season when moisture was a limiting factor.

The results also indicated that certain varieties performed better than others. The variety WL 318 gave consistently higher yields than all other varieties, especially during the dry period of the year.

#### Percentage flowering

All the seven varieties flowered and set seed within 6 weeks of regrowth. The percentage of plants that flowered for each variety ranged from 11.3 for Mohawk to 67.5 for WL 318 and with a mean of 29.0 (Table 1). The generally low percentage flowering observed is in agreement with observations by Medler (1958) that alfalfa is a long day plant which requires at least 14 h of photoperiod for flowering to occur. The fact that some plants flowered in this environment suggests that with careful selection, varieties can be developed that can flower profusely to produce seed under the present circumstances. In the absence of any such breeding programme, the variety WL 318 can be grown in Ghana to produce forage as well as seed when the need arises. Self-seeding to regenerate old pastures is also possible. Again, the presence of insects capable of tripping the flowers is a positive indication that seed production is possible. The integration of honey bee-keeping with alfalfa production would not only enhance honey production but also alfalfa seed production.

#### Conclusion

There was problem with the initial establishment of the crop as a result of initial slow growth of seedlings and competition with weeds. Early weed control is, therefore, essential to ensure good stand establishment.

As many as 16 insects were observed on the crop, but except for termites which chewed the stem and crown of some plants leading to their death during the dry season, none of the other insects caused any substantial damage. There is, however, the need to study these insects to know their economic importance on alfalfa and devise strategies to overcome any harmful ones among them.

Some varieties flowered profusely and set seed while other varieties flowered sparingly. The ability of some plants to flower indicated that local seed production is possible.

Dry matter yields for the seven varieties studied ranged between 21.0 to 24.2 t/ha for 10 cuts in the first year of growth. Yields per cut were high during

the rainy season but low during the dry season. Moisture availability, therefore, appears to be the major limiting factor to regrowth after each cut.

Among the seven varieties evaluated, the variety WL 318 obtained from ILCA in Ethiopia was outstanding with respect to dry matter yield, leaf-stem ratio, rate of regrowth after cutting, and ability to flower and set seed. Further studies need to be carried out on this variety with the view of recommending it for cultivation in Ghana.

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