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Phosphorus fertilization of vetch and medic cultivars in Chaouia

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ملخص

قد استلفتت قطنيات الكلأ الأنظار كبديل لاستراحة الأرض في المنطقة المتوسطية . هذه التجربة الحقلية في تربة عميقة شيئًا ما بالشاوية قومت استجابة ستة أصناف للبيقه وستة أصناف للفصة 10, 20, 30 ,0كلغ فسفور بالهكتار. البيقه استجابت للفسفور مع ارتفاعات ب 12,5 % ، 22,5 % و 33,8 % على التوالي لثلاث مقادير بالنسبة للعينة الشاهدة رغم أن إحداهما . V.Villosa زيادة عن Lathyrus ochrus استجابت ببلاغة .أما زراعة الفصة لم تستجب للفسفور . البيقه اعطت مردودية عالية بالنسبة للفصة. كما تجاوزت البيقه المحلية الأصناف التجارية الأسترالية .يمكن ارجاع اختلافات إستجابة للفسفور بالنسبة للسنوات الماضية إلى عوامل مثل زراعة متأخرة ، جفاف بعد زراعة عميقة. وقد عينت هذه الدراسة بعض قصور مع إبرازقيمة البيقه.

الكلمات المفتاحية : جفاف - استراحة الأرض الغير المحروثة - التخصيب الفوسفاطي- البيقه - الفصة- الشاوية - المغرب

Résumé

Les légumineuses fourragères ont attiré l'attention comme remplaçant de la jachère dans le ley-farming dans la région méditerranéenne. Le présent essai au champ, sur un sol peu profond (Petrocalcic Palexeroll) dans la Chaouia, a évalué la réponse de six cultivars de vesce (*Viscia* spp) et six cultivars de medicago (*Medicago* spp) au phosphore (0, 10, 20, 30 Kg P/ha). Les vesces ont en moyenne répondu au phosphore avec des augmentations de biomasse de 12,5%, 22,5% et 33,8% respectivement pour les trois doses par rapport au témoin, bien que seule *V. villosa* L., en plus de *Lathyrus ochrus* L., ait répondu significativement. Les cultures de medicago n'ont pas répondu au phosphore. Les vesces ont donné des rendements, en général, supérieurs aux medicago dont les locales ont surpassé les variétés commerciales australiennes. Les différences de réponse des medicago au phosphore avec les années précédentes pourraient être dûes à des facteurs tels que le semis tardif, la sécheresse après le semis et le semis profond. La présente étude a identifié quelques limitations des medicago tout en mettant en relief la valeur des vesces.

Mots clés: Sécheresse - Ley-farming - Jachère non travaillée - Fertilisation phosphatée - Medicago - Vesce - Chaouia - Maroc

Summary

Leguminous forage crops have attracted considerable attention as fallow replacement in ley-farming in semi-arid Mediterranen areas. Of primary concern is the role of phosphorus fertilization. This on-farm trial on a shallow soil (Petrocalcic Palexerol) in Chaouia, Morocco, evaluated growth responses of six cultivars of vetch (*vicia* spp) and six of medic (*Medicago* spp.) to applied P (0, 10, 20, 30, Kg/ha). Vetches on average responded to increasing P, i., 12.5%, 22,5% and 33.8% increase in biomass yield respectively with increasing treatments compared to no P application, but medic cultivars did not respond. Of the vetches, only one cultivar, *V. villosa* L. and *Lathyrus ochrus* L. significantly responded to P. Vetches, in general, yielded higher than medics, while local medics did better than Australian commercial ones. The discrepancy with previous P responses for medics may have been due to factors such as late planting, drought after planting, and deep incorporation of the seed. The study identified some limitations of medics while highlighting the potential value of vetches.

Key words : Drought - Ley-farming - Weedy fallow - Phosphorus fertilization - Medic - Vetch - Chaouia - Morocco

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INTRODUCTION

As the potential for bringing new additional land into cultivation in Morocco is limited, efforts to expand output have, of necessity, to focus on increasing crop yields or animal product output per hectare (8). In the semi-arid (250-450 mm) and marginal cereal-producing zones of Morocco, one approach to achieving this goal has been ley-farming. In essence, this involves the use of annual medics (*Medicago* spp.) as a substitute for "weedy" fallow in the cereal-fallow rotation (10). If possible, this would transform weedy fallow into N-fixing forage legume pastures, with an improvement in animal-carring capacity and possible beneficial residual N value for the succeeding cereal crop. The significance of this replacement can be deduced from the fact that at any one time up to two million hectares are in fallow (3).

Though research on medics is relatively recent for the North African region, work of DERKAOUI (4), involving assessment of genotype-environment interactions, showed that medics were generally well adapted to the semi-arid conditions of Morocco. Adaptive research has shown that medics should be seeded in the Oct.-Nov. period at about 20 Kg/ha and incorporated to a depth of 3-4 cm (6). A major concern in the effort to enhance establishment and growth of medics has been the impact of P fertilization. While most of the research on fertilization has dealt with cereals (1;2), the network of on-farm P fertilizer trials was enlarged to encompass other crops.

A recent field trial (5) clearly showed how responsive medic cultivars (Sava, Cyprus, Serana) can be to applied P (0, 15, 30, 60 Kg P/ha). An expanded range of cultivars exhibited varying degrees of response in a P deficient soil in the greenhouse. These encouraging results prompted a comparison under field conditions of P fertilization of medics with vetches (*Vicia* spp.), another common legume that could be considered as an alternative to medics in the non-cereal phase of a rotation. Thus, six cultivars of medic, five cultivars of vetch and one Lathyrus vetch were evaluated under a range of fertilizer treatment rates in an area where the soil is shallow and drought-prone and where fallowing is practiced.

MATERIALS AND METHODS

The site of this on-farm trial was adjacent to Settat in the Chaouia region, Morocco. The soil was a shallow one (Petrocalcic Palexeroll) and typical of the high Chaouia plateau the previous crop was barley. Soil test levels of both N (2.8 ppm NO_3-N) and available Olsen P (4.0 ppm) were low. While the mean annual rainfall is 386 mm (9), the actual season's rainfall was considerabley lower (277 mm); this was recorded at Sidi El Aydi about 15 Km west from the site. Also, rainfall was erratically distributed; there was no rain in November, heavy rains in December (72 mm), no rain from mid-December to mid-Februray, and adequate rainfall in late Februray (81 mm), and March (93 mm), and some in April (9 mm).

The land was prepared by two passes of an offset disc harrower "covercrop". Fertilizer was hand-applied as triple superphosphate at 0, 10, 20 and 30 Kg/ha. Subsequently, five cultivars of vetch, six of medic, and one Lathyrus (table i), were hand-applied to their respective plots with adjusted seeding rates to achieve 400 plants/m^2 at emergence. Seeds and fertilizer were incorporated by shallow disking Plots were 2 x 5 m. The design was a split-plot in a randomized complet block with 3 replications. P rates were the main plots and plant genotypes the sub-plots.

Table I. List of *Medicago* (M) and *Vicia* (V) cultivars

Species	Origins
1. *M. polymorpha*	Local ecotype
2. *M. polymorpha*	"Serana", Australia, commercial cultivar
3. *M. polymorpha*	"Tessaout", local ecotype
4. *M. polymorpha*	"Béni-Mellal", local ecotype
5. *M. scutellata* (L.) Mill	"Sava" (SNAIL), Australia, commercial cultivar
6. *M. trunculata* Gaertn	"Cyprus", Australia, commercial cultivar
1. *V. Lathyrus ochrus*	INRA origin, local
2. *V. Sativa*	Common vetch
3. *V. Villosa*	Hairy vetch, local
4. *V. Villosa 384*	INRA
5. *V. Dasycarpa*	INRA
6. *V. Narbonensis*	INRA

During the early growth stage, weeds were controlled by hand-pulling. Harvesting was carried out by cutting with hand sickles on May 15, 1991. Total fresh weight from each plot was then weighed at the site. Moisture samples were taken, dried and the weights again recorded.

RESULTS

The species, medic, vetch, and Latyrus differed in their response in terms of biomass weight to applied P. This is illustrated in figure 1 which shows that, on average, as P increased from 0 to 10, 20, and 30 Kg P/ha, dry matter yields of vetch correspondingly increased by 11.7%, 22.7%, and 33.6%, respectively. Dry weights of medics were considerably lower than those of vetch. Increases in medics were only slight and were not consistent with application rate.

However, an examination of the data indicated considerable variation between individual medic or vetch cultivars in terms of yield and P response. Thus, it was evident that

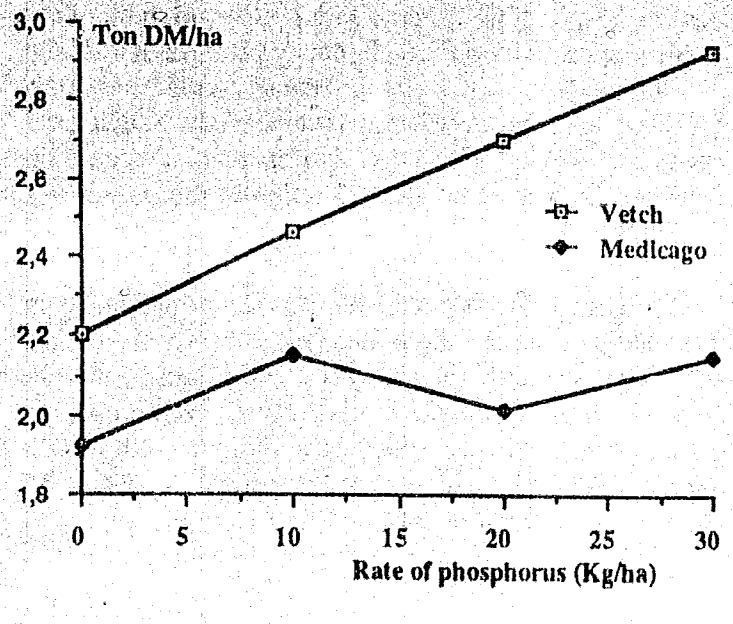

Figure 1. Overall mean dry matter yield response of medic and vetch cultivars to applied P.

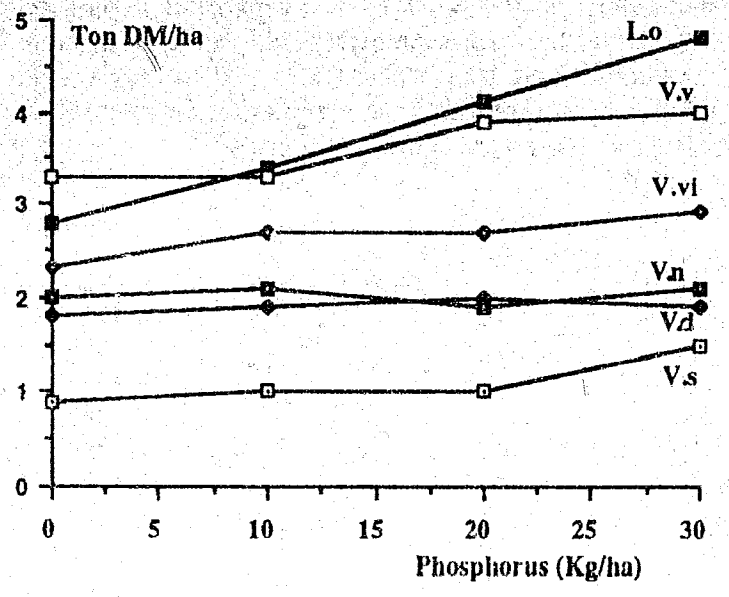

Figure 2. Mean dry matter yield response of six vetch cultivars to applied P. L.o: *Lathyrus ochrus*; V.v: *V. villosa* 3184; V.vi: *V. villosa*; V.n: *V. narbonensis*; V.d: *V. dasycarpa*; V.s: *Vicia sativa*

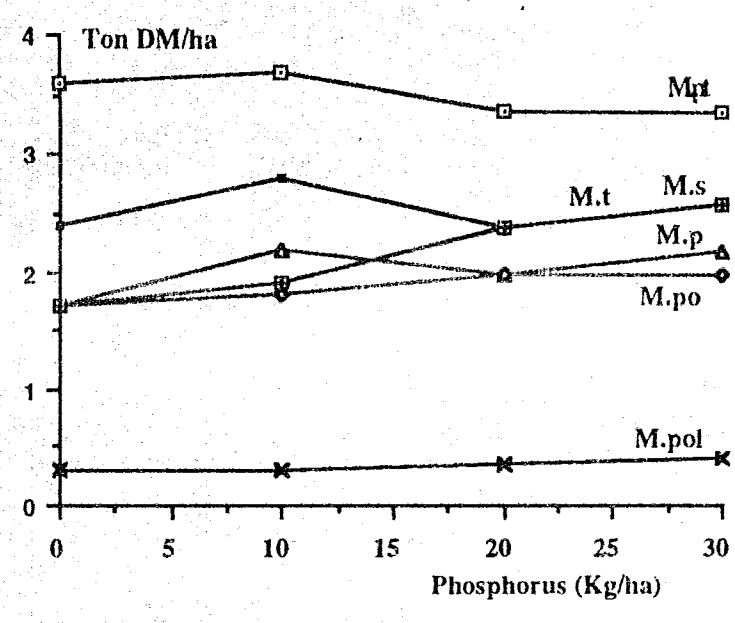

Figure 3. Mean dry matter yield response of six medic cultivars to applied P. M.p.t: *Polymorpha* (local) tessaout; M.s: *scutellata* (sava); M.t: *M.truncatula* (cyprus); M.p: *M. polymorpha* (local); M.po: *M. polymorpha* (local) Beni-Méllal; M.pol: *M. polymorpha* (serena)

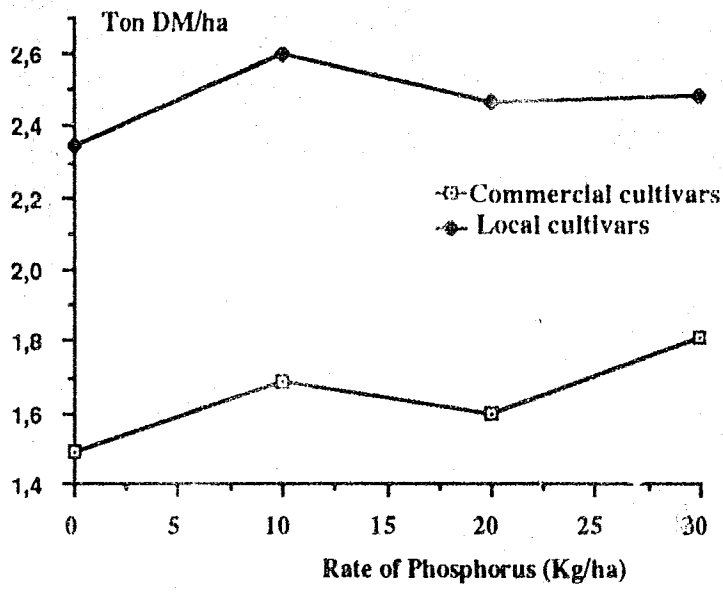

Figure 4. Mean biomass yield response of local and commercial medic cultivars to applied P.

only one vetch cultivar, *V. Villosa* 3184, and *Lathyrus ochrus* significantly responded to P, while the others showed only a slight response (figure 2). The two P responding cultivars had the highest biomass yields also.

While there were yield differences between medic cultivars (figure 3), there was no evident response to applied P; most varieties conformed to the general response pattern (figure 1). The local ecotype "Tessaout" was consistenly higher yielding than the other five cultivars. Of interest also was the fact that mean yields of the three local ecotypes were higher than those of the commercial cultivars of australian origin (figure 4).

DISCUSSION

While field crops in the semi-arid dryland zone can be expected to respond to applied P in "normal" years and when initial levels of available soil P are in the deficient range, this trial indicated some limitation to their generalization at least for medics and vetches. This was also indicated in previous studies (7) carried out at Sidi El Aydi on a deep clay soil (calcic Argixeroll). The absence of any consistent response of the medics to applied P was in marked contrast to a previous study at the same general site and with a similar deficient level of available P (5). The

dichotomy is illustrated by a comparison of biomass yields for the three commercial cultivars which were common to both trials (table II). Not only was there no consistent P response in the current trial (1990-91), but absolute yields were considerably lower.

Table II. Seasonal comparison of P response of commercial medic cultivars for fresh biomass yield

Cultivar	Season	P Application Rate[1]			
		P0 (t/ha)	P1 (t/ha)	P3 (t/ha)	P3 t/ha)
M. scutellata	1989-90	8.0	21.3	25.0	26.4
"Sava"	1990-91	5.3	6.2	4.9	5.5
M. truncatula	1989-90	14.1	20.3	23.3	22.6
"Cyprus"	1990-91	3.8	4.3	4.9	5.5
M. polymorpha	1989-90	4.9	4.1	6.6	8.5
"Serena"	1990-91	4.3	4.7	3.7	4.7

[1]Rates for 1989-90 were 0, 15, 30, and 60 Kg P/ha while for 1990-91 they were 0, 10, 20 and 30 Kg P/ha.

A number of possible explanations may be given for this discrepancy. The primary factor was probably seasonal rainfall and temperature differences. The period of stand establishment and subsequent growth for the 1988-90 trial was relatively normal with adequate rainfall and favorable distribution from the time when the crop was planted (Dec. 7), until May, after which it was harvested (May 15).

The current trial experienced low and erractic rainfall, following planting in December (Dec. 26), no rain fell during the entire month of January until February 17. The stand had to survive a residual moisture from earlier rains; this was further accentuated by the limited moisture-holding capacity of this shallow soil, i.e., 25-35 cm. Similar results were obtained on M. Truncatula *Cyprus* in 1986 (a wet season) and 1987 (a dry season) at Sidi El Aydi (7). Crop drought stress during this period was also exacerbated by higher than normal temperatures, i.e., maximum and minimum values for January were 20.5°C and 4-5°C, respectively.

While moisture limitation had an overriding influence of P availability and crop response, the poor yields may have been partly due to lateness of emergence in the current trials by comparison with the 1989-90 trial which emerged 45 days earlier. Another compounding factor may have been due to the fact that the former trial involved shallow (0-3 cm) seeding by hand-raking, while the latter involved deeper incorporation (0-10 cm) using the disc harrow.

It is thus apparent that moisture availability and management factors can have a profound influence on how medics respond to P fertilization. Considerable field experimentation is obviously needed to identify all the factors involved with P fertilization of medics and allow for more definitive recommendations. The fact that local ecotypes appear to perfom better than commercial cultivars in less than ideal conditions merits serious consideration.

The more favorable response of vetches and lathyrus than medics under such adverse conditions draws attention to the latter crop and the fact that some cultivars respond to P while others do not. Though preliminary in nature, this field trial suggests a more complete and longer-term field evaluation of P fertilization of medics and alternative forage crops.

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