

Dryland triticale : varying seeding rates and nitrogen fertilization

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Abstract

An on-farm trial at settat, and at a drier site further south at skhour Rehamna, considered the interaction between seeding and N application rates for triticale (*tritico-secale*). While yields differed between location, both factors increased yields at both sites. There was a significant seeding rate x N interaction at the more favorable Settât site, but not at the Skhour Rehamna site. Thus, N did not compensate for the reduction in seeding rate, probably due to the low tillering capacity of triticale. With conventional broadcasting, seed rates in the order of 160-200 kg/ha seem justified when used with adequate N fertilization.

Key words : fertilization, nitrogen, seeding rate, tillering, triticale

Résumé

La culture du triticale en sec : effet de la variation de la dose de semis et de la fertilisation azotée.

Deux essais ont été installés chez les agriculteurs à Settât et à Skhour Rehamna pour évaluer l'interaction entre la dose de semis et l'engrais azoté pour le triticale (*Tritico-secale*). Même si les rendements ont été différents d'un site à l'autre, les deux facteurs ont permis une augmentation du rendement sur les deux sites. Il y avait une interaction dose de semis x N significative à Settât et non significative à Skhour Rehamna. L'application de l'azote n'a pas compensé la réduction causée par la faible dose de semis, probablement en raison de la faible capacité de tallage qui caractérise le triticale. Dans le cas du semis à la volée, une dose de 160 à 200 kg/ha semble être justifiée quand elle est accompagnée par une fertilisation azotée adéquate.

Mots-clés : fertilisation, azote, densité de semis, tallage, triticale

ملخص

التريتكال المطري : تغيير كمية البذور و الأسمدة الأزوتية

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الهدف من هذه الدراسة التي أجريت عند المزارعين في منطقة سطات ومنطقة صخور الرحامنة هو معرفة العلاقة الموجودة بين كمية البذور وكمية الأسمدة الأزوتية المستعملة لزراعة التريتكال. رغم الاختلاف في الإنتاج بين المنطقتين فإن كل من كمية الأزوط وكمية البذور المستعملة ساعدت على ارتفاع الإنتاج في المنطقتين. أما التفاعل بين كمية الأزوط و كمية البذور المستعملة فلم يلاحظ إلا في منطقة سطات. لم يعوض استعمال الأزوط النقص في كمية البذور وذلك راجع بالأخص إلى قلة تفريخ التريتكال. إن استعمال 160-200 كلف من البذور في الهكتار عند البذر بالطريقة التقليدية قد تكون مجدية حال استعمال الأسمدة الأزوتية.

الكلمات المفتاحية: تسميد، أزوط، كمية البذور، تفريخ، التريتكال

Introduction

Efficient cereal production involves agronomic and cultural aspects. Seeding rate is a major concern in the semi-arid zone, where broadcasting by hand is much more common than drill seeding. The latter is more amenable to adjustment of precise seed quantities. Hand-broadcasting followed by incorporation with the disc harrow usually results in an uneven and poorly distributed crop stand. As a result of poor seed quality with respect to germination, and susceptibility to insects and diseases since little or no seed treatment is employed, farmers commonly use considerably higher seeding rates than researchers. Such rates may produce no increase in yield.

One study on barley seeding rates, involving the use of a drill at 45, 90, 135 kg/ha (Zouttane 1986 and 1987), found no difference due to varying seed amount. Similarly, with wheat cultivar nesma of *Triticum aestivum* L., Bouchoutrouch (1986 and 1987) showed no obvious differences in yield between 60 and 150 kg seed per hectare. However, Boutfirass' data for durum wheat (1986) indicate a lower optimum rate when seed is drilled compared to broadcasted. While barley has been known to tiller well, less is known about this aspect of triticale (Nachit and Malik 1983).

Similarly as N is so crucial for cereal yields, especially if rainfall is reasonable, i.e., < 300 mm, the possible effect of N in compensating for reduced seed rates needs to be considered. Unnecessary use of seed without any return in yields reduces a farmer's net profit. The global potential of triticale as a commercial cereal crop (Skovmand *et al.* 1984) has stimulated interest in its suitability for the stressed growing conditions in Morocco. While one study showed excellent responses of triticale to N (Ryan *et al.* 1992) and compares favorable with barley in terms of yield (Ryan *et al.* 1991), a constant seeding rate (160kg/ha) was used. How the possible range of seed rates would respond to varying N levels is unclear.

Material and methods

As with most fertility-related on-farm trials at the Aridoculture Center, this trial was also conducted at the Ben Ahmed road site near Settât, which represents one of the most common soil types in Chaouia and at a drier site to the south near Skhour Rehamna with a similar shallow soil. Site details are shown in table 1. According to criteria for dryland soils in the region (Ryan and Matar 1990), levels of soil N and P were deficient and were likely to respond to fertilizer application.

Table 1. Site details

	Settât	Skhour Rehamna
Soil type	Petrocalcic Palexeroll	Xerorthent ¹
NaHCO ₃ -P (ppm)	4.0	3.1
Nitrate-N (ppm)	2.8	2.0
Mean annual rainfall (mm)	386	260
Season's rainfall (mm)	277	255
Previous crop	Barley	Fallow

¹ Probable classification

As in standard procedure for such trials, and in line with farmer's practice, the site was tilled with an offset disc harrow. As P was not a variable, triple superphosphate was broadcasted at 30 kg/Pha. The N treatments were : 0, 30, 60, 90 and 120 kg N/ha as ammonium nitrate; because of expected response limitations, the highest rate was omitted at the Skhour Rehamna site. Also broadcasted by hand was the triticale seed "Juanillo" at rates of 40, 80, 120, 160 and 200 kg/ha, a range that spans that used by farmers. Both fertilizer and seed were then worked into the soil with the disc harrow. Individual plots were 4x5 m.

Design was a randomized split-plot with N treatments as main plots and seeding rate as sub-plots. Treatments were in triplicate. The planting dates were Nov. 30

(Settat) and Dec. 3 (Skhour Rehamna), while the respective harvest dates were May 24 and June 7. Weeds at the Settat site were controlled by a standard spraying of "Certrol H"; the Skhour Rehamna site was essentially weed-free and was not sprayed. Harvesting was by hand sickle, with whole plot measurements of total biomass. Grain yield was estimated from threshed sub-samples. The grain was analyzed for total N with Kjeldahl digestion.

Results

All main factors - location, N and seeding rates - had significant effects on triticale yield parameters. At the broadest level, data from the sites differed, as anticipated, due to differences in rainfall. Mean total dry matter or biomass yields were considerably higher at Settat (6.34 t/ha) than at Skhour Rehamna (4.03 t/ha). Corresponding grain yield figures were 2.08 and 1.13 t/ha, respectively. However, the trends were reversed when grain N content was considered; values at Skhour Rehamna were 1.58 % compared to 1.40 % at Settat.

Nitrogen increased yields at both sites. Relative increases at Settat were not consistent with N application rate but tended to increase with increasing N, i. e., from 60 % at 30 kg/ha to 72 % at 90 kg/ha. The latter rate produced the highest mean yield (7.4 t/ha) compared to the control (4.5 t/ha). At Skhour Rehamna, the respective increases at 30, 60 and 90 kg/ha were 18, 39 and 28 %. The maximum mean yield (4.6 t/ha) occurred at 60 kg N/ha compared to 3.3 t/ha for the unfertilized control. The highest rate at this site tended to depress yields. Increased in grain yield followed a similar order of magnitude.

Increasing seeding rates had an overall effect on biomass yields (Fig. 1). For instance, at Skhour Rehamna, relative increases were 37, 50, 69 and 77 % as seed rates increased from 40 to 200 kg/ha. The increases at Settat were much lower, i. e., 6, 9, 25 and 35 %, respectively. However, mean effects of N or seeding rate have to be seen in the light of interactions between these factors.

The interaction between seeding and N application rates was significant at the Settat site but not at Skhour Rehamna. Relevant total biomass data are thus presented in table 2 as a function of both parameters for both locations. Nitrogen had a greater effect at the higher seeding rates, i. e., 80 kg/ha and above. Higher values were recorded at the highest seeding rate combined with 90kg N/ha followed by 120-160 kg seeding with the heaviest N rate. At Skhour Rehamna, a similar trend was observed with little or no effect of N at the two lower seeding rates. For grain yield, a similar response pattern was exhibited (Fig. 2).

Grain N content (Table 3) tended to increase with increasing N application rate. For instance at Settat, mean N % value increased from 1.23 for the control to 1.59 at the highest (120 kg/ha) N level. Nitrogen had no consistent effect at Skhour Rehamna. Similarly, seeding rate had no consistent effect on grain N concentration. However, mean value tended to be higher at Skhour Rehamna than Settat. Thus, N percentage appeared to be inversely related to grain yield. This was probably due to the fact that drought or moisture was a more limiting factor than N at the Skhour Rehamna site.

Table 2. Impact of nitrogen at varying triticale seeding rates on biomass yield (t/ha) at two locations

Location	Nitrogen kg/ha	Seeding rate (kg/ha)				
		40	80	120	160	200
Settat	0	4.4	3.0	3.8	4.1	6.2
	30	5.5	7.3	6.4	6.9	8.3
	60	5.8	6.2	4.8	7.1	5.8
	90	5.6	6.1	7.4	8.6	9.3
	120	6.6	7.0	8.1	8.1	6.5
Skhour Rehamna	0	2.6	3.1	3.5	3.7	3.8
	30	2.6	3.8	3.8	4.7	4.8
	60	2.9	4.3	5.1	5.4	5.6
	90	2.9	3.9	4.4	4.8	5.3

LSD 5 % = 0.67

Table 3. Influence of nitrogen and seeding rates on grain Nitrogen concentration

Seeding rate kg/ha	Location		Nitrogen rate Kg/ha	Location	
	Settat	Skhour Rehamna		settatt	Shkour Rehamna
40	1.47 a	1.65 ab	0	1.23 d	1.61 a
80	1.38 a	1.46 b	30	1.23 c	1.54 a
120	1.41 a	1.59 ab	60	1.35 c	1.54 a
160	1.38 a	1.66 a	90	1.47 b	1.63 a
200	1.37 a	1.54 ab	120	1.59 a	-

Within columns, different letters denote significant differences.

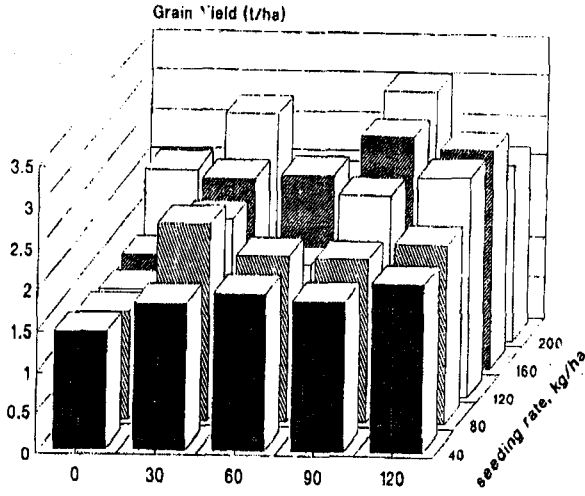


Figure 1. Relative mean increase in biomass yield with increasing triticale seeding rates at two locations

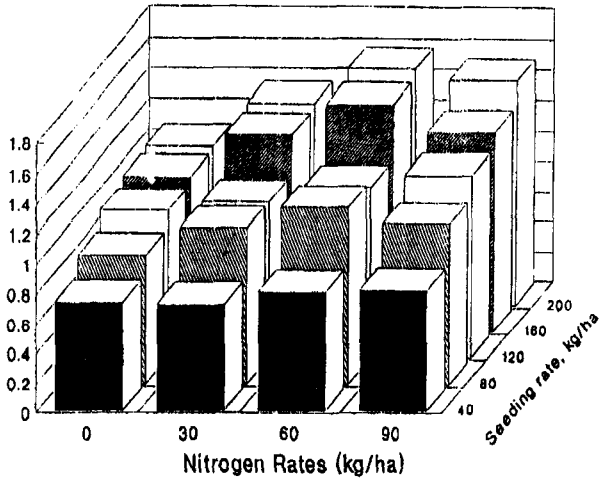


Figure 2. Grain yield response of triticale in relation to seeding rates and nitrogen fertilization

Discussion

The study underlined a number of aspects of cereal production in Morocco's semi-arid zone (250-450 mm/yr). It confirmed previous observations regarding the crucial role of rainfall in dictating yield potential irrespective of fertilizer inputs. For instance, Ryan *et al.* (1991) showed that mean yield at the more favorable Settât site (380 mm) were almost double that of Skhour Rehamna, which is normally much drier (225 mm). In the light of previous work at those sites (Ryan *et al.* 1991) and at Settât (Ryan *et al.* 1992), the responses to N were hardly surprising. It was again evident that a relatively lower amounts of N should be used in drier areas, i.e. < 300 mm.

The relationship between seeding rates and N fertilization was of interest. Despite the interaction, it was clear that increasing the seeding rate alone had a major impact on yield, especially at the Skhour Rehamna site. As triticale has relatively poor tillering capacity (Nachit and Malik 1983), higher seeds rates in the order of 160-200 kg/ha are necessary for adequate stand establishment. Increasing N alone at the lower seeding rate had no impact on yield at the drier site. As the response to N increased with increasing seed rate, both factors should be considered for maximum production.

Protein content, as reflected by N concentration in the grain, is less frequently assessed than grain or straw yield. While N can increase grain protein to a limited extent depending on the response, i. e., from 7.7 to 9.9 % as N increased from 0 to 120 kg/ha, what is of interest is that these values are considered less than early triticale lines (Skovmand *et al.* 1984). Future work on triticale will have to pay more attention to nutritional aspects in addition to agronomic ones.

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