DISCUSSION PAPER
No.6

Planting Methods for Winter Crops in NW Syria

by

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PREFACE

This Discussion Paper was written by Jim Harvey, an agriculturalist with ICARDA's Farming Systems Research Program. It is based on information collected by 'Abd el Karim Ferdawi, Haitham Halimah, Maria Halajian (all Research Assistants with the Program) and the author.

The study of planting methods for winter crops in NW Syria was made as a supplement to the Farm Systems Village Level Studies (VLS). Additional interviews were conducted during 1978 in 14 NW Syrian villages where seed drills have recently been introduced. Further information came from discussions with Government officials and seed drill manufacturers in the private sector.

This paper is intended primarily for scientists at ICARDA and for agronomists and other researchers slsewhere in the Near East and North Africa.

The paper is seen as complementary to the Internal Document 'Farming Systems Research Report No.2' which gives a more general discussion of the cropping systems and practices of NW Syria.

Transliterations of Arabic words are underlined in the text.

CONTENTS

SUMMARY

This paper reviews the planting methods used for winter crops in north west Syria. The information presented and discussed was collected from interviews in NW Syrian villages and from discussions with Government officials and machinery manufacturers.

The first section reviews the status of broadcasting, the methods used for covering the seed, the seed rates used, and the different plant establishments (plants/m^2) obtained on broadcast fields of three soil types in seven villages.

The second section highlights the use of seed drills in Syria, the history of their development and their present status - some 2087 were in use in Syria in 1977. The cultivations required for drilling are described, as are the different methods of fertilizer application. Seed rates for drilling are compared to broadcast rates, and the plant establishments on adjacent plots on farmers' fields are compared for drill vs broadcast methods. It appears that farmers, by using the drill, are aiming for higher plant populations. Yields of cereal crops in NW Syria have generally increased with the introduction of drilling, although this increase is associated with other factors such as fertilizer and new high yielding varieties. Seed drills are still limited to distinct areas of Syria, and are mainly centred on the larger farms, where in some cases they have been used for many years. However, they are being used increasingly on smaller farms through contract hiring.

In the final section the factors affecting the adoption of drilling in Syria are discussed. These include the availability of tractors, local land conditions which are often difficult, and the availability of machinery for hire. An increase in drilling in Syria is predicted, but it is stressed that in agronomic and "on farm" experimentation it cannot be assumed that drilling is "just around the corner". This applies to countries in the Near East and North Africa other than Syria. It is suggested that simple alternatives to the conventional drill could be studied by ICARDA. The effects of banding fertilizers, particularly phosphates, could also be particularly important.

INTRODUCTION

This paper describes methods currently used in NW Syria, and in some other parts of ICARDA's Region, for planting wheat, barley,lentil and vetches. The subject has relevance to crop improvement efforts because most of the area is broadcast sown, while much research work and many "packages of practices" involve use of seed drills. However, in NW Syria at least, the use of drills on farmers' fields appears to be increasing, and this affords us an opportunity to examine some of the factors involved and to consider the implications for ICARDA's work.

The seed drill is an interesting example of mechanisation in that it is one of the few agricultural machines that, whilst substituting for labour, can be expected to have a direct effect on yield or net output. It is also relatively expensive, so we need to know to what extent owners of smaller farm might make use of it.[1/]

The information discussed here was obtained from interviews in 14 NW Syria villages where seed drills have recently been introduced, from discussions with Government officials and private sector farm equipment manufacturers, and from data collected in the Farm Systems Village Level Studies (VLS). Although drills are also being used for food legumes, the bulk of the information discussed here refers to cereal crops.

1/ In Syria, 50 per cent of holdings are of 7 ha or less, and 70 per cent of 18 ha or less. Field sizes are consequently small, often below 2 ha. This pattern is reflected in many other countries of the Region served by ICARDA.

Reference is made to rainfall zones and soil types which are described more fully in Appendix I.

1. EXISTING METHODS

1.1 Broadcasting

The art of hand broadcasting is highly developed, though the skill is said to be becoming rarer as more of the younger members of farm families take up non-agricultural work away from their villages. Equipment such as seed fiddles and seed barrows is not used. On smaller holdings, farmers usually broadcast their own seed and fertilizer, although hired-in labour may be sought for larger fields or where a farmer knows his own skill is lacking. The availability of specialist broadcasters is variable, but only in those villages where slightly larger holdings predominate is this a significant problem or expense e.g. Jerablus district and VLS village 4/04. Work-rates for broadcasting seed range between 4 to 6 ha/day and wage rates are about LS 25.00/day[1/] or between LS 5.00 and 8.00/sack. Fertilizer broadcasting rates range between LS 2.00 and 4.00 per 50 kg.

One response to a shortage of labour has been the introduction of tractor-mounted spinners; these are increasing in number both on larger holdings and as a contractors' machine. Both locally made and imported models are available, and over 250 units of the former were sold up to 1979, initially to the irrigated areas south of Aleppo, but more recently to the higher rainfall areas of rainfed farming. These machines are relatively cheap, ranging from LS 1800 to 2400, but can suffer from inconsistent field performance. Work-rates are of the order of 3 to 4 ha/hr and hiring rates vary from LS 1.00 per 50 kg of fertilizer up to LS 15 and 20/ha, depending on application rates and locality.

1/ 1 LS = US $ 0.25

It is interesting to note that in Europe, in order to reduce costs, there has been a partial return to mechanised broadcasting from drilling. However, the situation may not be technically analogous with that in Syria in that many factors, such as soil nutrient status and weed competition, may be different.

1.2 Covering

Seed may be covered by an animal-drawn feddan plough, cultivator, disc harrow, mouldboard and disc-ploughs, or taban (simple iron-bar leveller).

Table 1 shows the frequency of methods used on plots sampled for yield in Aleppo Province.

TABLE 1. PROPORTION OF PLOTS COVERED BY VARIOUS METHODS IN ALEPPO PROVINCE IN 1979 (excluding drilled plots)

	Proportion of plots covered (per cent)							
	Zone 1		Zone 2		Zone 3		Zone 4	
Method[2/] Crop:	W[1/]	B	W	B	W	B	W	B
Feddan	-	9	-	-	9	6	6	5
Cultivator	89	65	65	61	91	94	28	26
M/B plough	11	-	-	-	-	-	-	-
Disc harrow	-	-	5	-	-	-	33	32
Taban	-	26	30	39	-	-	33	37

1/ W = Wheat; B = Barley

2/ The disc plough, although used in some areas, was not used on any of these plots.

Source: Farm Systems Village Level Studies.
151 plots sampled for yield determination.

1.2.1 Feddan

Animal-drawn ploughs are used mainly on the smaller holdings and exceptionally steep or rocky plots. On deeper soils, one pass with the plough sets up ridges ('ayar cultivation), the seed is then broadcast and a second pass (rdad) splits the ridges. Broadcast seed tends to concentrate in the 'ayar furrows and the majority of seed is therefore buried at maximum depth, which is about 10 cm. Row-spacing is about 40 to 45 cm and row band width 10 to 15 cm. On very shallow soil, the first pass is usually omitted, seed being broadcast on untilled ground and covered by rdad. The field is worked in bouts of 10 rows, a little over 4 m, which represents one broadcasting width. Work-rates are about 0.4 ha/day for a single pass. Owing to the degree of control that can be exercised by the operator, the feddan plough can be a highly effective implement for covering to an even depth.

1.2.2 Cultivator

Incorporation of seed by cultivator represents the 'tractorisation' of the feddan cultivations. The cultivator is used with five to seven tines carrying ducksfoot shares and in most cases additional "gaiters" to help form the ridge. 'Ayar and rdad are performed as with the feddan plough, giving a slightly wider row-spacing of 45 to 50 cm and a band-width of 15 to 25 cm. The broadcasting width is nine rows (again just over 4 m) formed by two passes of a five-tine cultivator.

Farmers recognize that the cultivator is slightly inferior to the feddan, even when used properly. Further problems arise if row-width and tractor wheel track width are mis-matched, and when different tractors perform 'ayar and rdad. Mis-matching results in a very variable covering depth with some rows emerging from the ridge top, others from the sides and others in the furrow bottom. Such careless operation, although observed on a proportion of plots, was not reported as a serious problem by the farmers interviewed.

The work-rate is about 1 ha/hr for a single pass, or twenty times faster than by feddan. Thus in an eight hour day, one tractor and broadcaster can plant about 4 ha. Hiring rates vary between LS 20 and 60/ha for 'ayar and rdad together.

Table 1 - indicates that the cultivator is now the commonest way of covering seed except in the driest zones. It can be used on sticky (i.e. late-planted) and stony soils, but the ridges created by both cultivator and feddan have a slight disadvantage for combine harvesting.

1.2.3 Mouldboard plough

In Aleppo, seed covering by mouldboard plough is confined to the higher rainfall areas above 500 mm mean annual rainfall. It is used in place of the cultivator on stickier wetter soils and where grass weeds are more of a problem. The plough has to be run at a shallow depth and control is consequently difficult, resulting in very uneven seed cover and plant density. Work rates are 1.5 to 2.0 ha/hr, and hiring rates in VLS village 1A/13 are about LS 70/ha for 'ayar and rdad together.

1.2.4 Disc plough

This is rarely used in Aleppo, but is observed in Hama Province, particularly in VLS IRR/01. Like the mouldboard plough, it results in a rather uneven covering and plant density. Work rates are similar to covering by mouldboard plough, and hiring rates in VLS village IRR/01 are LS 100/ha for 'ayar and rdad together.

1.2.5 Disc harrow

The disc harrow, mostly of the single-axle offset type carrying seven to ten discs, is popular in the drier zones and steppe, on lighter soils, and in some irrigated areas e.g. VLS village IRR/09 in Hama Province.

Plant spacing is random, and the distribution reflects the pattern of broadcasting. The disc-harrow can be used in conjunction with other implements i.e. after 'ayar by cultivator, or vice versa. Work-rate is about 1.5 ha/hr and rates of hiring for a single pass (rdad) are between 20 and 30 SL/ha.

1.2.6 Taban

The taban can be used to cover seed broadcast onto ridges made by a cultivator. It levels the ridge-tops, burying seed more shallowly than by other methods, and leaves a fairly level seedbed. It is preferred for barley covering (see Table 2) as the combine harvester can subsequently cut the crop nearer to the ground, but can only be used on stone-free and fairly dry soils. It is also cheaper, at LS 5 to 10/ha, than the cultivator and faster, covering up to 2 ha/hr. The main disadvantage is the poor covering ability and the subsequent higher seedrate required to compensate for uncovered seed.

The taban has also been used on lentil where farmers have wished to attempt machine harvesting. However, it does not work well on sticky soils, and it is often not possible to use it for later planted crops. The taban is not so effective as other light harrows, for example "zig-zag" or flexible chain types.

1.3 Seed rates for broadcasting

Seed rates reported by farmers are fully presented in Farm Systems Project Report No. 2 (ICARDA Internal Document) Section 5. A summary is given in Table 2 below:-

TABLE 2 SUMMARY OF SEED RATES ON BROADCAST FIELDS REPORTED BY FS SURVEY FARMERS

Village	Date	Seed rate (kg/ga) Wheat	Barley	Lentil
1A/13	1977	124	-	147
	1978	127	-	130
1B/05	1978	130	143	156
2A/06	1977	130	132	148
	1978	134	156	131
2B/01	1977	48	56	-
	1978	57	75	-
3/02	1977	99	92	100
	1978	105	112	121
4/04	1977	73	92	-
	1978	98	102	-

Source: Farming Systems Village Level Studies

In general, seed rate is lower in drier areas and on shallow soils (e.g. VLS village 2B/01). Rates are slightly higher for barley than for wheat. Little information is available on percentage purity and germination, although in some cases these can be low. However, farmers in the VLS survey frequently purchase seed of better quality if their own seed is substandard.

1.4 Plant establishment on broadcast fields

Table 3 shows plant establishment in the same six villages, measured after emergence and before tillering.

TABLE 3 PLANT ESTABLISHMENT

		Plant establishment (plants/m^2)								
		Wheat			Barley			Lentil		
Village	Season	Soil: 1	2	3	1	2	3	1	2	3
1A/13	77/78	281	302	-	-	-	-	-	-	-
	78/79	267	201	-	-	-	-	196	170	-
1B/02	77/78	204	146	-	153	-	-	231	-	-
1B/05	78/79	252	192	-	313	227	-	226	241	-
2A/06	77/78	209	-	-	194	-	-	-	-	-
	78/79	239	224	189	221	128	145	322	315	332
2B/01	77/78	-	-	-	103	92	-	-	-	-
	78/79	125	102	102	120	118	72	83	97	-
3/02	77/78	151	-	-	-	-	-	270	-	-
	78/79	-	218	-	226	-	177	325	-	227
4/04	77/78	157	-	-	173	-	-	-	-	-
	78/79	126	106	-	216	212	181	-	-	-

Source:- Farm Systems Village Level Studies. Data and methods are fully reported in Farming Systems Research Report No.2 (ICARDA Internal Document) Section 5.

For wheat, populations generally decrease with rainfall zone and soil type. Barley shows no apparent trend with rainfall, but there are lower populations of the crop on shallow soil. No general trends are noticeable with lentil.

Given a mean 130 kg/ha and 135 kg/ha for wheat and barley respectively on deep soils in zones 1 and 2, and assuming 1000-grain weights of 35 and 40 g, the maximum possible establishment would be in the order of 3.7 and 3.4 million plants/ha. The counts in Table 3 indicate establishment percentages of around 65 per cent, suggesting considerable losses.

2. THE USE OF SEED DRILLS

2.1 History of Development

The seed drill has one of the longest development histories of any agricultural machine, and in Western Asia has been known for several thousand years.[1/] Early drills were simply additions to, or adaptations from, ploughs to allow seed to be trickled into the furrow bottom behind the share. This method is still in use in Syria, where summer crops such as sorghum, sesame and cotton are sown behing a feddan plough equipped with funnel, tube and coverer.

However, for winter crops with higher seed rates, drill development dates from much later. During the 17th century several machines were designed, and a few were actually built, which consisted mainly of the addition of a seedbox to an existing plough. The 18th century saw the development of the precursors of modern drills, in that they were purpose built, carried several coulters, and had a force-feed metering mechanism. Much controversy raged as to whether the drill itself was responsible for increases in yield, as its introduction frequently was accompanied by other changes, but 'seed economising' was apparently a definite advantage.[2/] Nevertheless, in many of the earlier developing countries, drills were in widespread use for the sowing of winter crops by the last quarter of the 19th century. Many variations and improvements on the design have since been made, and a wide range of models is currently available on the world market. These include the disc-seeder, with its non-precision seed placement,and various types of deep

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1/ Such a drill is shown on a seal cylinder found at Tel Asmar and dating from about 2000 B.C. (Fussell, 1973).

2/ In England, several 18th century examples of seed saving by early drills are documented, ranging from 30 to 50 per cent of the amount usually broadcast sown. (Fussell, 1973, pp.88,92).

furrow and press drills, which pay particular attention to where, and how, seed is placed. Such precision obviously increases the expense, and the cost per coulter can range from $250 to $900, according to the complexity of the machine.

2.2 Seed drills in Syria

Modern drills first made an appearance in Syria in the 1950's, but were confined to the larger land holdings, particularly those of the north-east. Most were of conventional design and fitted with single-disc coulters; this meant that they performed well on the lighter soils of al-Jezireh and the drier areas of the western provinces, where pre-rains planting was the normal practice, but did not become popular on the heavier soils, or where post-rains planting was preferred.

Manfacture of drills commenced in Aleppo in 1973. In the early years, sales were slow, despite advertising and exhibiting at national trade fairs, but now over 750 units have been sold, mostly from 1976 to 1979. According to the manufacturer, all but a few machines have been sold in the north-west, in areas where few drills were previously used. However, sales have been concentrated in distinct areas, and result from buyers having seen the advantages of drilling on neighbouring fields.

The total number of drills in use declined from 1929 units in 1971 to 1656 units in 1973, but increased to 2087 units in 1977 (Central Bureau of Statistics, Damascus, 1978).

2.3 Aleppo drills

Seven models are currently manufactured, having from 12 to 24 coulters. All are three-point mounted end-wheel drills having a fluted-roller metering mechanism driven from the ground wheels. Seed rate is nominally adjustable between 30 and 180 kg/ha. Both single-disc and hoe coulters are available, but the great majority of drills sold are fitted with the hoe type, which are much better suited to the wetter zone soils than discs. Row-width is fixed at 17.5 cm. Prices (1979) start at LS 5,500 for the twelve-row up to LS 9,100 for the 24-row model. Average price per coulter is LS 457 ($ 105).

The drills are simple, light and generally robust but there is no facility for cleaning out the hopper, and sophistications such as deep furrow coulters and press wheels are not available. Farmers report few operating problems with the exception of seed-rate adjustment, which has to be made on a somewhat *ad hoc* basis. The drill copes adequately with rough or stony ground and the 17.5 cm row spacing is usually wide enough to prevent trash build-up.

The manufacturer has considered two particular modifications: reducing the row-spacing to 10 cm, and including a combined seed and fertilizer drill in the range. The first has been discontinued after tests, owing to blocking problems, but the second is being planned for manufacture in 1980. The present capacity is three to four units/week.

2.4 Drill ownership

Whilst previously drill ownership was limited to the larger landowners, farmers in the areas of recent adoption, i.e. Jerablus and Idleb/Hama, report increasing numbers operated by village tractor owners. In one Jerablus village, where holdings ranged between 10 and 35 ha, all village tractors were equipped with a drill.

It would appear that it is mainly the privately-owned village drills that are available for hire, as in all villages visited farmers reported that large land-owners' drills were generally not for hire. In one village it was stated that drilling had been known for 20 years on large holdings, but had not been adopted by smaller farmers because of the unavailability of machines for hiring.

2.5 Drill users

In those villages where contract drills have been available for several years,almost all farmers were reported to use them. In other villages, where the drill has made a recent appearance, as many as 50 per cent of farmers have used the drill in the first season. Whilst few drilled plots were observed in these areas during visits in 1977, by 1980 they constituted a majority. Drilled crops were even seen on small, stony and sloping fields.

Farmers with small holdings have also taken to using drills, as for example in one village where holding size ranged between 0.5 and 6.0 ha.

2.6 Work areas and utilization

Contract drills were reported to cover between 10 and 30 ha/day depending on size and number of hours worked. Most drills sold in the last five years have been in the smaller size categories, which average little over 1 ha/hr, and the normal rate is probably between 10 to 15 ha/day. Seasonal use varied between 15 and 30 days and the expected annual utilization should therefore be between 150 and 450 ha.

Al-Hassakeh province, which claimed in 1977 over 67 per cent of all drills in Syria, had in that year an average of 610 ha of wheat and barley planted to each machine. This figure over-estimates drill utilization, as a proportion of the Hassakeh crop is broadcast, but it gives some comparison.

Even if annual utilization was at the higher end of the range, viz. 450 ha/season, we might estimate that in 1977 a maximum of 18 per cent of the wheat and barley area, excluding al-Hassakeh province, was planted by drill, and the remainder broadcast sown. The estimate would be 75 per cent for al-Hassakeh.[1/]

2.7 Cultivations for drilling

Under broadcast post-rains planting conditions the two cultivations 'ayar and rdad play an important role in weed control. In these areas, at least one post-rains cultivation is required before drilling.

All villages reported one cultivation prior to drilling, and some reported two. The second pass is usually made to incorporate broadcast fertilizer. If a cultivator is used, it is usually fitted with a taban to provide a more level bed for the drill. Again, a common zig-zig harrow would almost certainly do a better job.

2.8 Fertilizer application

Two main methods of fertilizer application were reported:- (i) broadcasting and cultivating-in before drilling, and (ii) mixing seed and fertilizer together in the drill. Some farmers applied fertilizer and seed separately by drill in two passes.

1/ Estimates are based on data given in the Annual Agricultural Statistical Abstract, MAAR, 1978. Of 2087 drills recorded "in use" in 1977, 1397 were registered in al-Hassakeh. Al-Hassakeh accounts for about 33 per cent of Syria's wheat and barley area.

Farmers regarded fertilizer as something of a problem with the Aleppo drill, as seed and fetilizer mixtures tended to separate out and result in uneven applications. Farmers in several villages were familiar with combine drills, and indicated that this was one particular improvement they would like to see in the Syrian models.

2.9 Seed rate for drilling

The most commonly stated advantage of drilling is economy of seed (Lovegrove, 1978). It is therefore surprising to find that in NW Syria, introduction of the drill has generally resulted in higher seed rates. This has been particularly marked in the Jerablus villages where the 80 to 100 kg/ha used in broadcasting has been increased to 130 to 160 kg/ha with the drill. Similar increases are reported elsewhere in the province. Farmers using drills for the first or second season only, generally reported no change in seed rate, and only one farmer of irrigated land reported a decrease.

Where seed rates have markedly increased, farmers report that this is the result of the more regular plant spacing afforded by the drill which allows higher populations to be used. If this is so, it implies that the plant distribution given by broadcasting and covering by cultivator is markedly sub-optimal. Certainly, observation shows intense competition within rows on broadcast plots. Additionally, adoption of the drill in the Jerablus area has been accompanied by a switch to HYV wheats and an increased use of fertilizer; possibly several interactions are involved.

2.10 Plant establishment

Plant counts were made on farmers'fields in two areas, Jerablus and Idleb/Hama, and these are shown in Table 4.

TABLE 4 PLANT ESTABLISHMENT OF ADJACENT FARMERS' FIELDS, JANUARY 1979

	Plant establishment (plants/m^2)		
Seeded/covered by:	drill	cultivator	taban
A) Idleb/Hama 1/			
Mean	333	233	264
S.D.	34	30	26
n	8	6	6
B) Jerablus 2/			
Mean	267	162	-
S.D.	36	28	-
n	14	5	-

1/ Crop planted December, after first significant rain.

Drill vs. cultivator significant (p = 0.01)

Drill vs. *taban* significant (p = 0.05)

2/ Crop planted November, before first significant rain.

Drill vs. cultivator significant (p = 0.01)

Similar counts were made at Tel Hadya on adjacent plots in a number of Farm Systems experiments and these are shown in Table 5.

TABLE 5. PLANT ESTABLISHMENT ON ADJACENT PLOTS IN FARMING SYSTEMS PROGRAM EXPERIMENTS AT TEL HADYA 1978/79, 1979/80. ALL SEED RATES 120 kg/ha

		Plant establishment (plants/m^2)	
Experiment	Season	Drill	Cultivator
3-course, deep soil (wheat)	1978/79	257	178
n		5	4
2-course, deep soil (wheat)	1978/79	252	150
n		6	6
2-course, shallow soil (barley)	1978/79	242	128
n		7	7
3-course, deep soil (wheat)	1979/80	325	177
n		5	5

All drill vs. cultivator comparisons significant (p = 0.05)

With a common seedrate in Table 5 of 120 kg/ha it can be ssen that drilling gave a consistently better establishment than broadcasting and covering by cultivator. Using approximate 1000-grain weights[1/], it can be estimated that establishment percentages are about:

	Wheat	Barley
Drill	75%	81%
Cultivator	47%	43%

Thus to attain a given stand, the drill should use about 40 per cent less seed than broadcasting and covering; this compares with work in Jordan where a 30 per cent seed saving was reported (Sanders, et al. (1970) in FAO(1975)).

1/ 1000-grain weights used are 35.5 and 40 g for local wheat and barley respectively, which are averages for material harvested on farmers' fields.

If these establishment percentages are applied to the populations in Table 4, it would appear that in Idleb/Hama, use of the drill should be accompanied by lower seed rates, whilst in Jerablus, establishment differences could be explained by technique alone. Given that increases in seed-rate are reported, especially in Jerablus, it is possible that the Tel Hadya estimates show too much favour to the drill, and that probably the establishment under broadcasting of 43 and 47 per cent is unusually low.

Time of emergence is affected by planting method, and crops at Tel Hadya were observed to emerge up to 7 to 10 days earlier if drilled. This could give a crop a significant advantage in some seasons. It may also help explain the establishment percentages given above, should counting have been done before full emergence on broadcast plots.

What is apparent, however, is that with use of the drill, farmers are obtaining, and presumably are aiming for, higher populations. This may be the most significant interaction in drill use on farmers' fields.

2.11 Weed competition

All areas reported reduced competition from weeds on adoption of the drill, presumably on account of the closer row-spacing and higher plant densities. Very few farmers were reported to use herbicides and in the Jerablus area, weeds were said to be not a serious problem.

2.12 Yields

Whilst changes in population, spacement, time to emergence and weed competition indicate that there ought to be responses in yield to drilling, it has not been possible to demonstrate this so far on farmers' fields in NW Syria.

Sampling in 1979 showed no significant differences in yields of barley drilled, or broadcast and covered by cultivator or taban.[1/] Other sources of variation - soil, date of planting, fertilizer treatments etc. - mean that only very large numbers of sampled plots would allow detection of main effects. FAO (1975) were also unable to demonstrate yield advantages from drilling over broadcast methods in the Kerak district of Jordan, even under experimental conditions.

Nevertheless, yield advantages have been demonstrated experimentally in ICARDA's Region (Samios, 1974 ;Shaalan et al, 1977) and can probably be subsumed where existing practice results in severely sub-optimal stands[2/] or where a specialist drill is virtually essential to a system.[3/] A particular problem is that drilling is often associated with a "package of practices" and frequently it is not possible to separate out component contributions. The latter may, however, be of more interest to the farmer.

1/ Data from farmers' fields in Aleppo Province, 1979, gave:

	drill	cultivator	taban	significance
Yield (kg/ha)	2099	2075	2336	n.s.
Fertile tillers /m^2	374	395	412	n.s.
Initial population /m^2	333	233	264	$p = 0.05$
n	8	6	6	

The data does indicate for broadcast treatments that higher tillering may compensate for lower initial population.

2/ For example, FAO (1977) conclude for Irbed, Jordan that the existing methods (broadcast and disc-harrow) lead to uneven germination, a poor stand, and contribute to low yields.

3/ The deep-furrow drill is an important component of systems proposed for the Anatolian plateau; see "More Wheat from Fallow Farming" (1975), USAID/Oregon State University, Ankara, Turkey.

This problem has been experienced by farmers in NW Syria. All groups interviewed suggested that yields have generally increased with use of the drill, but that this was often associated with other factors. For example, in several Jerablus villages it was estimated that the best yields were now double what they were a few years age. Factors involved were increased fertilizer use, adoption of HYV wheats and use of the drill. Farmers felt able to rank the importance of these "package" components through having seen them adopted one by one and in different combinations, on the many different plots of small holdings. In order of decreasing importance they were: fertilizer, variety, drill.

2.13 Costs

Hiring rates for drills vary between LS 10 and 15/ha, and LS 30 and 35/ha if a pre-cultivation is included. This compares with 'ayar and rdad by cultivator at LS 20 and 25/ha. Therefore, for farmers normally broadcasting their own seed and fetilizer, the extra cost is small, and for those hiring labour, drilling costs the same or is even cheaper.

From the operator's point of view, the annual depreciation and interest on a 12-row drill (over five years at 6 per cent) would be LS 1300; or LS 4.00/ha based on an annual utilization of 300 ha. With tractor and driver costs at about LS 10.00/ha, it can be seen that hiring rates are competitive.

2.14 Other effects of drilling

2.14.1 Labour substitution

Obviating the need to find labour for broadcasting was mentioned as one advantage of drilling in all the Jerablus villages. This area, where holding sizes are slightly larger than the Aleppo average, has something of a general labour shortage, which is witnessed by the decline in lentil production in recent years.

In contrast, none of the Idleb/Hama villages reported having a broadcasting labour problem before they adopted drilling. In parts of the province where drills are virtually unknown, a first response to shortage of labour is to use tractor mounted spinners. For example, VLS village IRR/09, where no drills are available for hire, has increasingly used spinners for seed and fertilizer distribution. Some al-Hassakeh farmers use the spinner for a faster job over large areas, and to minimise costs.

2.14.2 Distributional issues

Any machine that substitutes for labour results in a redistribution of benefits from wage-earner to machine owner. For farmers of smaller holdings, adoption of drilling results in extra cash outlay, and general adoption may reduce the income earning opportunities for those families reliant on seasonal agricultural labouring. Owing to the low labour inputs involved in winter crop planting, the absolute value of redistributable benefits is likely to be small, but it is outside the scope of this study to estimate the impact on wage-earning families.

2.14.3 Level seedbed

All villages mentioned that the relatively level seedbed left by the drill was an advantage for combine harvesting.

2.14.4 Denser stand

The denser, more even stand resulting from drilling was reported in all villages to facilitate combining by giving an even feed to the header. It has the additional effect of reducing wind damage and shattering.

2.15 Adoption of drilling

Whilst farmers gave different empasis as to which of the advantages of drilling were more important, all agreed that adoption was due firstly to having seen the advantages demonstrated on neighbouring fields, and secondly to drills being available for hire at a competitive price for the first time. All villages visited had either experience of drills on the local landowners' fields (in which case the advantages must have been appreciated generally for several years before smaller farmers were in a position to use them) or had seen them in use in adjacent villages. The only drills found in use in predominantly "broadcast" areas were on larger holdings, and were not used for hire. In six VLS villages situated in such areas, farmers stated they had no experience of drilling and were not aware of any advantages.

Thus drilling is still limited to distinct areas, the nucleii of which appear to be the larger farms where drills have been used for many years.

3. DISCUSSION AND IMPLICATIONS

3.1 Factors affecting the adoption of drilling in Syria

Before 1973, seed drilling in Syria was almost exclusively confined to the larger holdings of al-Hassakeh province, and in the west to larger holdings on drier, lighter soil. Since then, there has been an increase in the number of drills in use, and they had made an apperance on small holdings in the higher rainfall areas of the west. A number of factors appear to have allowed this break-through.

3.1.1

More tractors of appropriate power size are available, and enough time has passed for some owners, many of whom may have been first time buyers since 1970, to recoup sufficient capital to reinvest in complementary equipment. Table 6 shows the increase in tractor and drill numbers since 1970.

TABLE 6. TRACTOR AND SEED DRILL NUMBER IN SYRIA 1970-77

Year	Tractor 37 kW	Drills
1970	2,929	-
1971	3,283	1,929
1972	4,705	1,660
1973	5,857	1,656*
1974	6,813	1,702
1975	9,030	1,903
1976	12,104	2,020
1977	14,227	2,087

* Manufacture of drills started in Aleppo

Source: Annual Agricultural Statistical Abstract, MAAR, 1978

More importantly, owing to the activities of the Agircultural Co-operative Bank and the Agricultural Co-operatives, many of these tractors are owned and operated in the small-farm sector. Nevertheless, all but 200 of the 750 drills sold between 1973-79 were sold directly by the manufacturer, i.e. without loan assistance, suggesting that they were mostly sold to the wealthier tractor owners.

3.1.2

A drill has been made available that was developed for local conditions i.e. that is simple, robust, cheap, and fitted with hoe-coulters. At LS 5,500, the smallest model, is only about 25 per cent more expensive than a good cultivator or disc plough. Imported models, whilst in some respects technically superior, are considerably more expensive, and in any case have not been available in Syria since 1966.

3.1.3

It is clear from talking to farmers that the advantages of drilling are sufficiently attractive to encourage them to use it provided that machines are made available for hire. This attitude was also reported in Jordan by al-Haj et al (1972), who, when investigating the reasons for non-adoption of drilling in Irbed, found that 61 per cent of farmers were aware of drill benefits, but could not "adopt" because machines simply were not available. Another 20 per cent could not use drills because of uneven land.

3.2 Future developments in Syria

All things being equal, we might confidently predict an increase in seed drilling in Syria. It has been empirically demonstrated as feasible on small holdings and on relatively rough terrain, and farmers seem pleased with the results. However, some caution is indicated:

3.2.1

The average seasonal capacity of drills in the western provinces will fall as the drill-sown area increases. This will happen as more and more small plot areas take up drilling, and as drill-planting moves more and more into the post-rains planting area which has a shorter planting season (herbicide use, allowing pre-rains planting in the wetter areas, might modify this).

3.2.2

Even if we assumed an annual utilization of 250 ha, some 5000 more units would be required before most of the cereal area in the west could be drill-sown. Including replacements, this is well beoyond the present manufacturers' capacity. Importation of cheap drills from elsewhere may not solve the problem if they cannot stand up to Syria's rough conditions, and high-quality machines may be too expensive for the market. Importation has other drawbacks, including foreign currency requirements and maintaining the availability of spare parts.

3.3 Implications for ICARDA and National Research Programs

3.3.1

It is probable that, despite the upsurge in drilling in Syria, broadcast-sown crops are going to be with us for some time to come, and we cannot assume in agronomic and "on-farm" experimentation that drilling is "just around the corner" for the majority of farmers. This may be even more important for countries whose indigenous farm machinery sector is less well developed than Syria's, and who may have to rely on relatively expensive imported machines.

3.3.2

The apparent interactions between method of planting, seed rate, spacement and population, demonstrated on farmers' fields, may have implications for agronomic work, particularly "improved" versus "farmers practice" type comparisons.

3.3.3

ICARDA is in a position to demonstrate quantitively the benefits of drilling. Such information is important for planners who wish to know how best to spend both local investment and foreign currency, and it is needed in addition to response data for variety, or fertilizer, or herbicide. Seed drills may ultimately prove one of the more difficult parts of a package for many farmers to adopt.

3.3.4

ICARDA may also be in a position to experiment with simple alternatives to the conventional drill which could facilitate the adoption of drilling. These might include the fitting of seed boxes to the ubiquitous nine-tine cultivator of offset disc (as is done in Cyprus) to make a simple drill that should be considerably cheaper than specialized models. Such work could also include investigation of row spacing and population interactions, to find out if wider spacings than the present drill's 17.5 might be more appropriate in some circumstances, as it may encourage early intrarow competition and reduce vegetative growth. (Bolton, 1979).. This whole question is nevertheless complex, especially when considering the many interactions that can take place on farmers' fields.

The effects of banding fertilizers, particularly phosphates, are worth quantifying. On the Region's phosphorous deficient soils, this may have a marked effect on the efficiency of P_2O_5 utilization.

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APPENDIX I

Agricultural zoning and soil productivity classifications in NW Syria

A) Agricultural zoning

The official classification of the Ministry of Agriculture is based on rainfall, and identifies five Agricultural Stability zones, the first of which is divided into two sub-zones. They are:-

Zone 1 a	Average rainfall over 600 mm
Zone 1 b	Average rainfall between 350 and 600 mm
Zone 2	Average rainfall between 250 and 300 mm and not less than 250 mm in two years out of three
Zone 3	Average rainfall over 250 mm and not less than this in one year out of two
Zone 4	Average rainfall 200-250 mm and not less than 200 mm in one year out of two
Zone 5	Below 200 mm, and covering the rest of the country.

B) Soil productivity

Farmers in the Farm Systems Village Level Studies (VLS) recognise several soil types by their productivity and physical characteristics. Broadly speaking they are as follows:

Type 1	Red/black, deep with a high cracking clay content
Type 2	Red/yellow, medium to deep, lower clay content
Type 3	Red/yellow/white, shallow to medium depth, frequently rocky.

An idea of the combined productivity differences according to rainfall zone and soil type is given in the table below:-

GRAIN YIELD OF BARLEY BY AGRICULTURAL ZONE AND SOIL TYPE
1979 SEASON

Soil type	Grain yield (kg/ha) Zone 1	Zone 2	Zone 3	Zone 4
1	2244	1362	584	471
2	1681	929	587	464
3	1185	696	505	281

Source:- Farmers' Field Sampling, VLS

For a further discussion of agricultural zoning and soil types see:-

Farming Systems Project Report No.1(ICARDA Internal Document), Section 2 (Physical Environment) and 3.2 (Crops), and Farming Systems Project Report No.2 (ICARDA Internal Document), Section 5.