Project Title :	**Runner bean quality: Evaluation of plant support systems for reducing bean distortion**
Report:	**Final Report (January 1998)**
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PRACTICAL SECTION FOR GROWERS

Scope and Objective

Runner beans with bent pods are generally discarded in the field or marketed at greatly lower prices than grade I produce. These losses may account for as much as 25% of the crop. Maincrop varieties such as Enorma produce straightest pods when growth is rapid and there is sufficient clearance for the pods to develop without mechanical constriction. Therefore pod straightness might be influenced by the plant support system used.

The most widely used support method is four bamboo canes tied in a 'wigwam' format (Figure 2) which often causes runners to become entangled at the apex of the wigwam and hence more bent pods. An alternative arrangement for plant support canes is an 'X' format which results in diverging pattern of growth and should allow greater clearances for developing bean pods. However, in commercial production, such arrangements have proved structurally weak or prohibitively expensive to erect. An experimental 'X' format system is being developed by Klick and Stick Limited (Harvington, Worcs) which is based on innovative use of extruded plastic and is potentially quicker to erect (Figure 1b).

There was no information on the extent to which these different systems might affect market quality. Work over one season was therefore sponsored by HDC to compare the novel 'X' system with the traditional 'wigwam' format and also a system based on the 'Hortonova' polypropylene netting system (Figure 1c) supplied by Tenax plastics.

Summary of Results

The two cane systems produced very similar yields at each of the harvests (Figure 2). With the net system, plants tended to become bushy at the base before starting to climb the net and consequently the first harvest pick produced poor yields and quality. In the second and third picks, yields were similar to the other treatments. No quality improvements were obtained with either novel X system or the net system compared with the wigwam system (Figure 3). The X system partially collapsed following heavy rain after the last harvest. Although this problem was solved by reconfiguring the method of erecting the system (Figure 4), the benefits of this modification have yet to be tested.

RECOMMENDATIONS

1. The cane systems proved better than the net system for initiating the climbing of bean runners.

2. In all three support more than 20% of the marketable crop was graded-out due to pod bending systems tested. Further work is necessary to investigate the causes of these losses including continuous monitoring of plant water stress.

3. The 'X' format cane support system produced yields and quality as good as, but no better than, the wigwam cane support system and was structurally weak. A stronger system was devised but needs to be tested.

4. Further work is also recommended to discover whether efficiencies can be achieved using an 'X' format system at higher planting densities and for a longer cropping season than those used in this trial.

Practical and financial benefits anticipated.

There is currently no advantage from adopting the 'X' format cane support system or the net system. Efficiencies that could be derived from use of the 'X' system at increased planting densities (land rents, irrigation, herbicides and fertilizers) need to be established in further trials and they would be partly offset by the increased costs for materials and labour in erecting the supports. Prices for a commercial 'X' system based on plastic extruded material are not yet available but high efficiency gains are likely to be necessary for economic feasibility.

SCIENCE SECTION

INTRODUCTION

Pod bending in runner beans can result in serious yield losses. Although the causes are not fully understood they are thought to result from any transient restriction of growth, such as water stress or mechanical constriction of the runners due to poor initial training. The traditional wigwam system of cane supports (Figure 1a) often causes entanglement of runners at the apex of the wigwam which can cause more bent pods. However, there was no information on the effects of different support systems on pod quality.

An alternative arrangement for plant support canes is an 'X' format which results in diverging pattern of growth and should allow greater clearances for developing bean pods. However, in commercial production, such arrangements have proved structurally weak or prohibitively expensive to erect. An experimental 'X' format system (Figure 1b) is being developed by Klick and Stick limited, Worcester which is based on innovative use of extruded plastic and is potentially quicker to erect. Work over one season was therefore sponsored by HDC to test the novel 'X' system under conditions approximating to those used in commercial practice by comparison with the traditional 'wigwam' format and also a system based on the 'Hortonova' polypropylene netting system (Figure 1c) supplied by Tenax plastics.

MATERIALS AND METHODS

Experimental design

Five replicated plots consisting of 10m lengths of bed were established for each system within a commercial crop planted on 6th June using double row beds (0.6m within row, 0.6m between rows and 1.8m between bed centres). Each of the three systems were arranged randomly within a block with a total of five replicated blocks.

Treatments

System A - Traditional wigwam cane arrangement set -up by the grower.

System B - 'X' cane arrangement (donated by 'Klick a Stick' Ltd).

System C - Polypropylene net ('Hortanova' donated by Tenax plastics) supported by wires suspended between wooden stakes.

All other crop husbandry treatments (spacings, herbicides, crop protection, irrigation etc) were the same as normal commercial practice carried out by the grower and applied at the same time as they were applied to the commercial crop.

Klik a Stik (X-format) system.

The system consisted of 150cm lengths of extruded plastic central support with section joints and positionable cane support clips. 7 ft bamboo canes were inserted at each plant station. The canes were inserted at the correct angle using a home-made triangular frame guide with two sides of 108cm and a base of 70cm. Six plastic sections were jointed together and laid down the centre of each plot. The cane clips were adjusted to correspond with the position of the canes then the central support was lifted into position (about 1m above the ground) and clipped onto the canes.

Net System

Round wooden posts (9ft x 4'') were set 10m apart using the tractor-mounted post inserter and secured to a steel anchor point at each end of a plot. Support wires were laid between the top and bottom of the posts, secured with staples and tensioned. Hortonova netting (13FG) was hung on the wires using net hooks.

Measurements

Three harvests were taken at one week intervals during September with one extra harvest taken for the wigwam system in October. Total pod weights from each plot were recorded as well as the weight of unmarketable pods discarded in the field due to over-maturity or contamination with soil. At every harvest, sub-samples of at least 50 marketable pods from each plot were taken to the laboratory for detailed measurement of pod dimensions. A straightness grading index was defined as the pod overall length divided by the shortest distance between the two ends of the pod. A perfectly straight pod gave an index of 1.0 whereas a very bent one was less than 0.8. To meet class I grade an index higher than 0.9 was judged necessary.

RESULTS

Harvest yields and field wastage

On each successive harvest pick the yields declined in all treatments. There were no significant yield differences between the wigwam and Klik a Stick systems but the net system produced both lower total and marketable yields at the second harvest and also higher proportional wastages on both second and third harvests than either of the other two systems (Table 1). Field wastage ranged from 0 (for all treatments in the first pick) to as high as 17% for the second harvest following a period of heavy rainfall.

Pod bending

The average pod lengths of marketable beans from all treatments in the trial was 33+/- 5cm. Over 95% of the picked crop reached the length required for class I grade (Table 2). Most rejects were due to bent pods and these accounted for 20% or less, except from the first harvest with the net system, where the losses were higher at 40% (figure 3). With this exception there were no differences in the proportion of bent pods between the treatments.

CONCLUSIONS

Bean yields and quality in the trial were typical for a good runner bean crop in Worcestershire. There were no quality improvements with either novel X system or the net system compared with the wigwam system. The only differences occurred with the net system at the first harvest where plants tended to bush out from the base rather than climb the net resulting in a higher proportion of unmarketable beans due to bent pods or soil contamination. The X system partially collapsed following heavy rain after the last harvest. Although this problem was solved by reconfiguring the method of erecting the system (Figure 4), the benefits of this modification have yet to be tested.

DISCUSSION

Although greater differences might have been found if the trial had involved earlier planted crops with a longer cropping season, the grade-out levels of 20% or more in all treatments indicated scope for improvement which was not influenced by the methods of plant support used. Transient water stress, if present, could conceivably have accounted for this bending and would have affected all plots similarly. Investigation of this possibility in further trials would be facilitated by the recent development of the infra-red thermometer technique for measuring plant water stress (FV 140, Project News 44).

Different support systems and plant populations might also be investigated for potential efficiency gains. Commercial crops based on cane systems generally use less than half the optimum density shown for string systems of about 100,000 plants per ha (ADAS booklet 2428). This is partly due to the wide spacings between beds required for mechanical operations. The 'X' system of cane support provides scope for reducing within-row spacing to achieve densities nearer the optimum while retaining the wide road spacings.

ACKNOWLEDGEMENTS

The trial was established at NE Reville and Son Ltd, Sandford Farm, Severn Stoke , Worcester, with help from Mr David Reville. I would also like to thank the Worcester Bean Growers Group and the Worcestershire Vegetable Discussion Group for helpful discussion and encouragement.

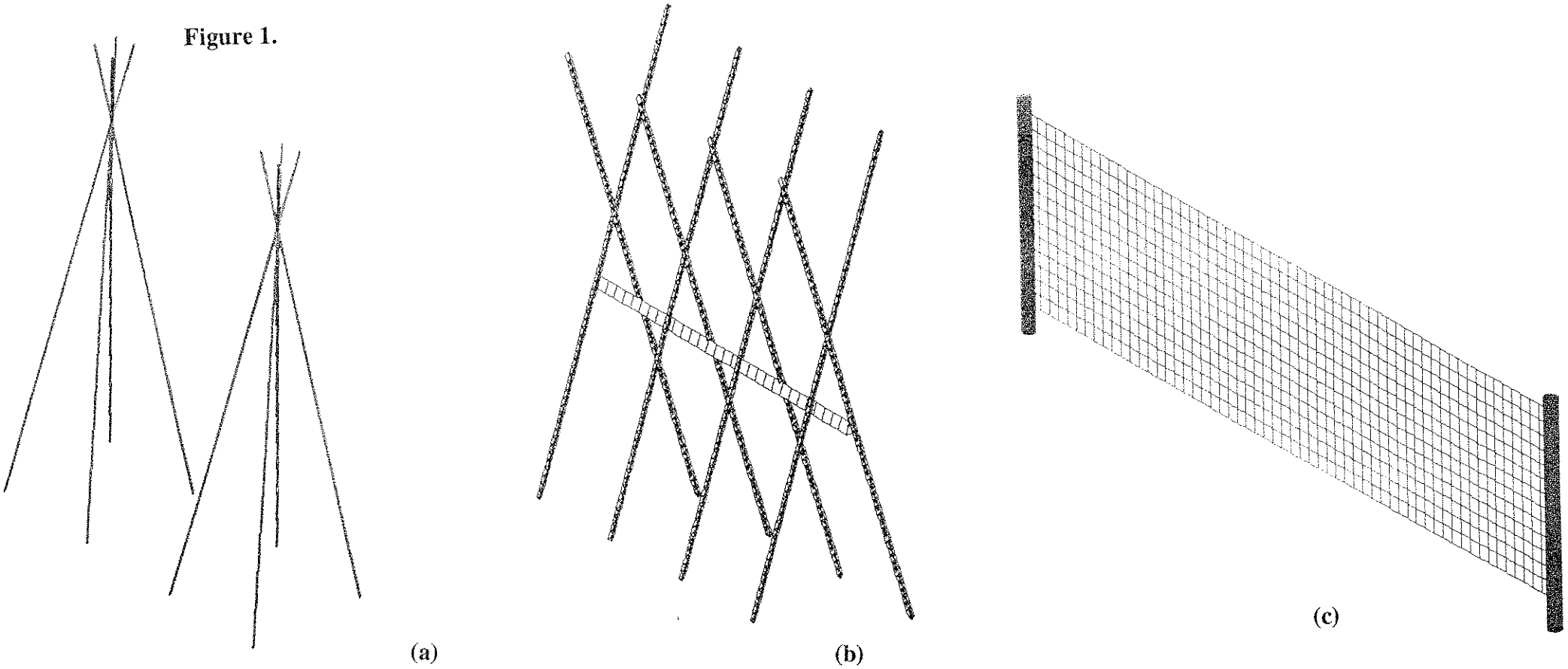
Table 1. Effect of support system on harvest picks and field waste

Harvest Date		YIELD tonne/ ha Wigwam	Std. dev	X-format	Std. dev	polyprop net	Std. dev
13-Sep	total	4.59	0.60	3.75	0.98	3.50	1.20
	marketable	4.59	0.60	3.75	0.98	3.50	1.20
	waste%	0.00		0.00		0.00	
19-Sep	total	3.41	1.07	4.03	1.04	2.58	0.75
	marketable	3.03	0.99	3.53	0.95	2.14	0.63
	waste%	11.22		12.47		16.95	
26-Sep	total	1.82	0.58	2.07	0.64	2.21	0.45
	marketable	1.76	0.50	1.95	0.62	1.97	0.42
	waste%	3.01		5.82		10.89	
04-Oct	total	1.82	0.60				
	marketable	1.55	0.54				
	waste%	14.46					
TOTALS	September						
	total	9.82	2.25	9.85	2.67	8.29	2.41
	marketable	9.38	2.09	9.23	2.55	7.61	2.25
	waste %	4.74		6.10		9.28	

Table 2. Effect of plant support system on bean length and straightness

		Wigwam	Std. dev	X-format	Std. dev	polyprop. net	Std. dev
13-Sep	overall length (cm)	34.5	6.08	34.07	5.1	33.9	4.4
	bend index	0.89	0.03	0.93	0.04	0.84	0.03
19-Sep	overall length (cm)	33.07	5.1	34.9	4.9	34.3	3.97
	bend index	0.9	0.1	0.91	0.09	0.89	0.16
26-Sep	overall length (cm)	31.6	5.4	31.7	5.2	32.5	4.8
	bend index	0.89	0.15	0.9	0.1	0.89	0.12

Figure 1.



Plant support systems used in the trial
(a) traditional 'wigwam' cane supports (b) novel 'X' cane supports (c) Polypropylene netting.

Figure 2.

Effect of plant support method on marketable yield

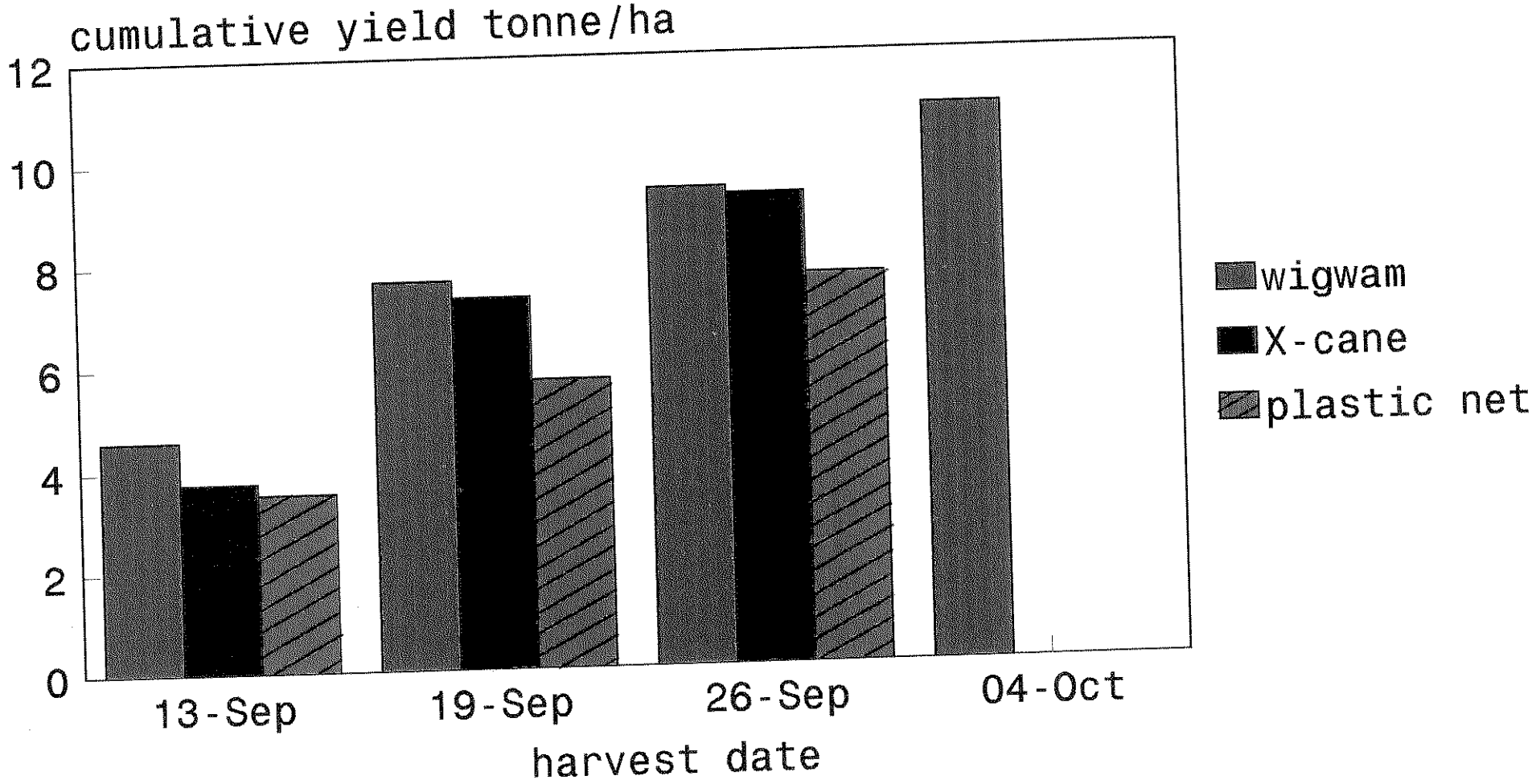
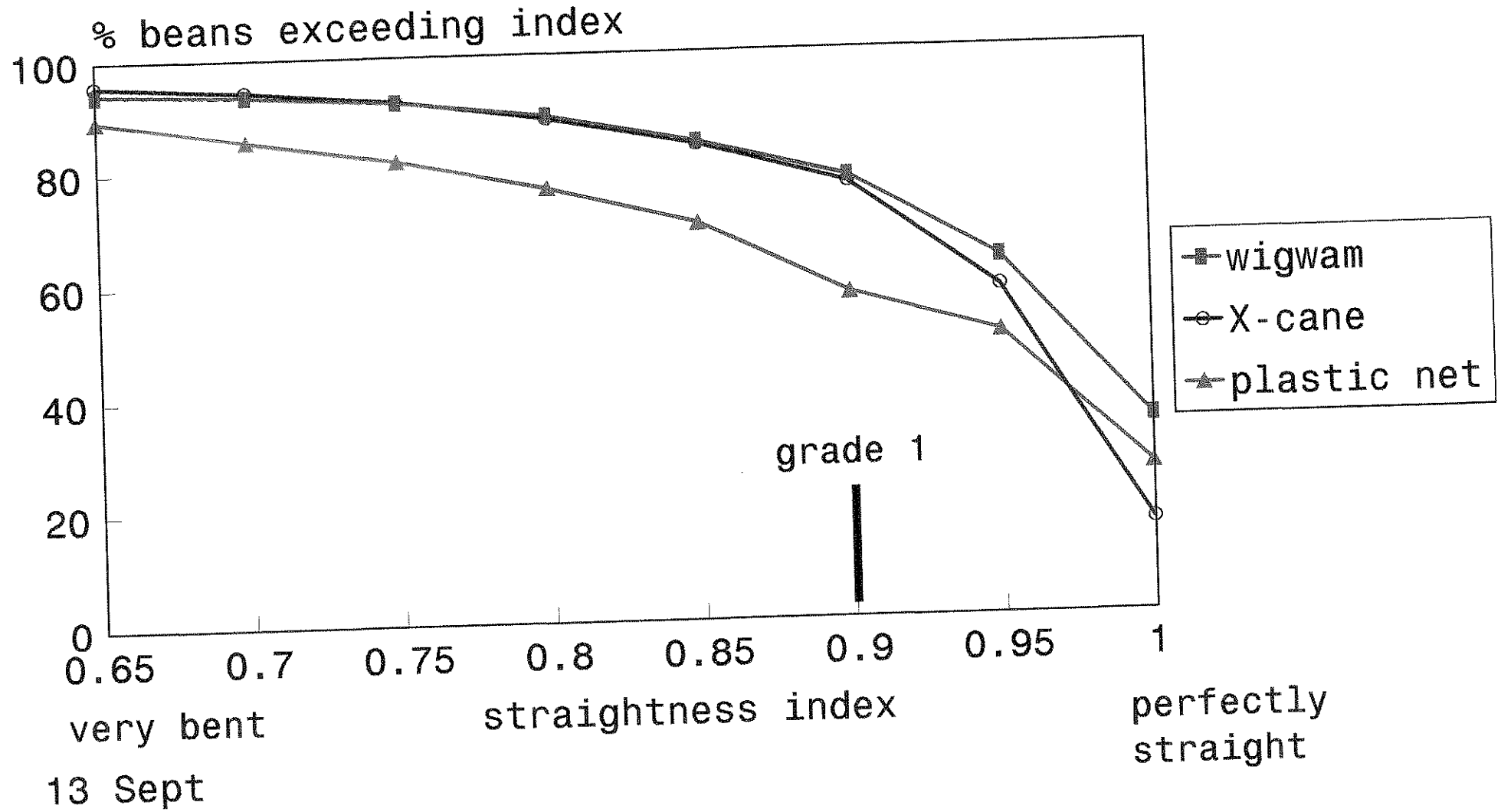


Figure 3.

Effect of plant support method on bean straightness



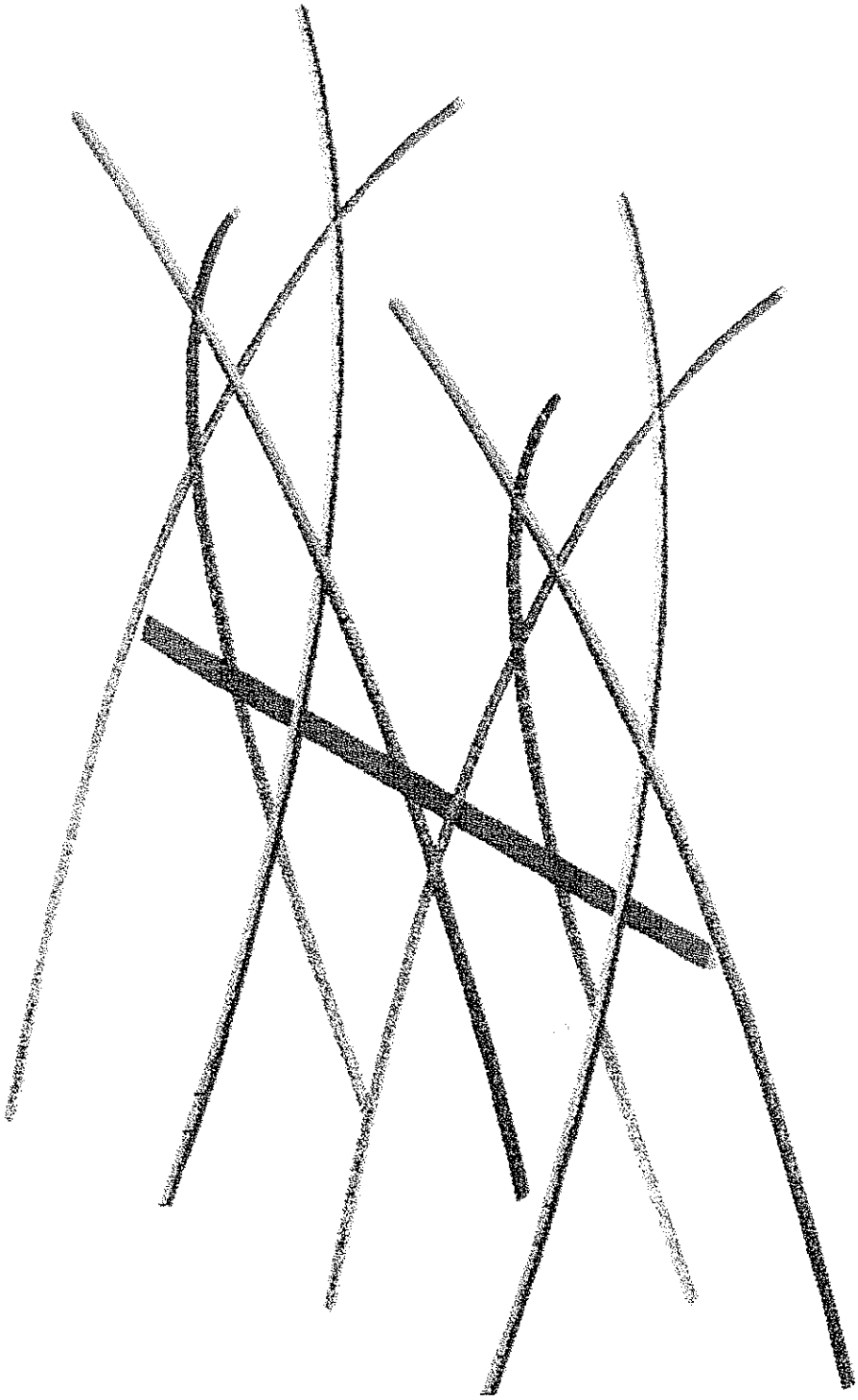


Figure 4. Adapted 'X' support system