A STUDY OF AGRONOMIC FACTORS AFFECTING THE YIELD AND QUALITY OF FORAGE MAIZE IN IRELAND

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ABSTRACT
The objectives of these studies were to examine the effects of sowing date and plastic film on the yield and quality of forage maize (*Zea mays* L) in a marginal maize growing area. The response, in DM yield terms, to sowing in early April rather than early May differed in 1995 and 1996, but early sowing in all cases improved quality parameters. The use of plastic film, whether perforated or complete cover treatments, gave substantial yield increases in some instances, and always improved quality parameters. Perforated plastic gave highest DM yield increases with late April or early May sowings, while most benefit from the complete cover plastic was obtained with early April sowings. Date of plastic removal was critical in determining the DM yield response to complete cover.

KEYWORDS
Forage maize, sowing date, plastic, DM yield, quality

INTRODUCTION
In Ireland, grass silage is the principal feed for overwintering ruminant livestock. This grass silage normally has a low dry matter content (DM%), and relatively low dry matter intake (DMI) characteristics. In addition, it suffers from large compositional variation between years, and between individual harvests within years. Maize (*Zea mays* L.) has been shown to have beneficial effects on forage DMI and animal performance in Ireland (Keane, 1973, 1988). However, as a C-4 plant with a high temperature requirement in the May-Sept.period, the performance of the maize crop in Ireland has often been sub-optimal. Consistency and level of performance has been improved by the development of earlier maturing and more cold-tolerant cultivars, with a resultant marked increase in the area devoted to the crop in Ireland. Agronomic factors may have similar benefits, particularly by improving the early vigour of the crop, thus leading to a faster achievement of optimum leaf area.

Previous work in Ireland and England (Bunting, 1968; Keane, 1993 and Ingram,1993) had indicated that early sowing (late April-early May) improved cob and grain percentage, but did not consistently improve dry matter yields. Slow germination and emergence due to low temperatures, and frost damage after emergence, often resulted from early sowing. The sowing of maize through clear plastic, which can increase soil temperatures, has been examined in Ireland and France (Keane, 1996; Mesnil, 1991) and was found to improve germination rate, early crop vigour and subsequent crop yield and quality. The possibility of sowing in early April under plastic, which might provide protection from frost/low temperature, seemed worthy of investigation.

The work reported here was carried out at the U.C.D. research farm at Lyons in 1995 and 1996, in order to study the effects of sowing date and plastic use on the yield and quality of forage maize.

MATERIALS AND METHODS
Two trials were carried out in 1995, and one in 1996. Plots, which measured 5m*4 rows (rows were 71cm apart) received normal commercial treatments in regard to seeding rate, fertiliser application and herbicide use. In Trial 1, plots were sown on April 11, 1995 in a randomised block design with three replications. There were four treatments, no plastic (NP), perforated plastic (PP) and complete cover plastic (CC) , which was removed on May 19 (CC1) or May 29 (CC2). In the PP treatments, the seed was sown through clear plastic, while in the CC treatments, the seed was sown first and covered immediately with clear plastic, which was removed by cutting between the crop rows on the appropriate date. In Trial 2, a split-plot design with three replicates was used, with sowing dates (April 11, April 25 and May 9, 1995) comprising the main plots, and plastic treatments (NP and PP) comprising the sub-plots. In Trial 3, a split-plot design with four replications was used, with sowing dates (April 11, April 25 and May 9, 1996) comprising the main plots, and plastic treatments (CC1,CC2,CC3,and CC4) comprising the sub-plots.The CC treatments refer to the number of days after emergence when the plastic was removed. Harvest dates were Oct. 6 for Trial 1, Oct. 5 for Trial 2 and Oct.10 for Trial 3.

At harvest, the centre two rows of each plot were harvested by hand, weighed immediately and subsampled (five plants). The subsample was separated into two components (cob and leaf\stem), and each of the components was dried separately in a force-draught oven at 50 C to constant weight to determine dry matter (DM), cob and grain percentage. Grain percentage was estimated by manually removing the grain from the cob immediately after removal from the oven. Starch and organic matter digestibility(OMD) were determined by NIR (LG Ensitec)methods.

RESULTS AND DISCUSSION
Data from these trials show that some of the plastic treatments gave substantial benefits in DM yield and quality terms, similar to what had been reported previously (Phipps, 1994; Keane, 1996) . In 1995, with April 11 sowing (Trial 1), the PP treatment gave lower DM yields than the NP treatment, due to severe frost on May 12/13, which caused 35% plant mortality under the PP treatment. No such damage was caused with the CC treatments, and CC2 treatment increased DM yields by 12%. In Trial 2, the PP treatment increased DM yields by 22.6% and 34.6% for April 25 and May 6 sowings, respectively, but gave lower yields than NP with April 11 sowing. In 1996, in Trial 3, PP gave higher yields than NP at all sowings, but the benefits from the CC treatments depended on sowing date and the date of plastic removal. Removing the plastic too early resulted in low-temperature damage, particularly with the April 11 sowing, while removing the plastic too late resulted in heat and mechanical damage, particularly with May 9 sowings. With the CC treatment, highest DM yields were obtained with the April 11 sowing, with plastic removal at Day 32.

The correct time for removing the plastic in the CC treatments appears to be 20-35 days after emergence, and is dependent on sowing date. It is possible that accumulated temperatures under the plastic and mechanical stress on the plants are important. All plastic treatments improved crop quality parameters (DM, grain and starch %), but had no effect on OMD.

The mean effect of sowing date on DM yield varied between years, as has been reported previously (Keane, 1993; Ingram, 1993), and the response would appear to be related to the temperatures obtaining in May and June. There was an interaction between sowing date and plastic treatment in relation to DM yield, e.g., PP gave highest overall yields with April 25 sowing, while the highest yield from the CC

treatment was obtained with the April 11 sowing, with removal at Day 32. Quality parameters, except OMD, were improved with early sowings.

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Table 1
Effect of plastic film on yield and quality of forage maize Means 1995-1996.

Plastic Treatment	*DM Yield t ha-1*	*DM gm kg-1*	*Grain*	*Starch*	*OMD*
			———gm kg-1 DM ———-		
Trial 1, 1995.					
NP	15.89	345	367	224	728
PP	12.11	401	490	322	745
CC1	15.07	510	506	354	738
CC2	17.82	503	493	351	738
Mean	15.22	439	464	313	737
F-test	*	***	***	***	**
SE(m)	0.53	10.0	9.4	11.0	2.8
Trial 2, 1996.					
NP	14.53	355	389	236	726
PP	16.19	454	487	318	728
Mean	15.36	405	438	277	727
F-test	NS	**	***	**	NS
SE(m)	0.69	11.0	10.0	13.5	2.8
Trial 3, 1996.					
NP	15.89	287	382	197	689
PP	19.13	36*			
SE(m)	0.49	8.0	13.1	20.9	9.0

NS = not significant; *= 5% level; ** =1% level; *** = 0.1% level.
SE(m) = standard error of mean.

Table 2
Effect of sowing date on yield and quality of forage maize

Sowing Date	*DM Yield t ha-1*	*DM gm kg-1*	*Grain*	*Starch*	*OMD*
	Means 1995-1996		*———gm kg-1 DM ———*		
Trial 2, 1995.					
April 11	13.49	438	487	330	731
April 25	15.38	388	421	260	728
May 9	17.09	373	407	240	723
Mean	15.32	400	438	277	727
F-test	NS	*	***	*	NS
SE(m)	0.81	12.4	4.2	12.3	3.3
Trial 3,1996.					
April 11	18.11	365	483	346	740
April 25	17.89	357	486	282	716
May 9	16.51	318	426	290	730
Mean	17.50	347	465	306	729
F-test	NS	*	**	*	NS
SE(m)	0.47	9.7	9.2	29.6	12.7

NS = not significant; *= 5% level; ** =1% level; *** = 0.1% level.
SE(m) = standard error of mean.