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CROPPAK: A CROP MANAGEMENT SYSTEMS MODEL

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ABSTRACT

CROPPAK is a one-year crop production and financial planning model available on AGNET (AGricultural computer NET work). AGNET is a management tool for agriculture designed to be used by people with no previous knowledge of computers. The CROPPAK model drew heavily on an AGNET program called FLEXCROP developed in Montana. Refinements of and additions to FLEXCROP by North Dakota Cooperative Extension Service and Agricultural Experiment Station staff at North Dakota State University in Agricultural Economics, Agronomy, Entomology, Plant Pathology and Soil Science were used to develop the present CROPPAK model. CROPPAK presently has 12 subroutines for each of 5 crops. These various subroutines can be used individually or in combinations. The fertilizer subroutine contains fertilizer recommendations for 26 crops grown in North Dakota. Several of the subroutines were tested on recrop wheat in 1981. The ability of the model to predict final wheat yield ranged from 2.2 to 10.5 percent for variety performance, 0.7 to 6.6 percent for fertilizer use and 4.9 to 18.7 percent for weed control. Numerous county Extension agents and external users are using the CROPPAK model to assist farmers and ranchers, ag lenders and bankers, farm managers and agricultural consulting firms to estimate crop yield potentials 4-9 months ahead of harvest and thus be able to better determine production input decisions.

I. INTRODUCTION

CROPPAK is a short range (one-year) crop production and financial planning model available on AGNET (AGricultural computer NET work). AGNET is a management tool for agriculture designed to be used by people with no previous knowledge of computers. The AGNET system currently has users in 39 states, 5 Canadian provinces and one other foreign country. The North Dakota Cooperative Extension Service serves as a contact for information and has AGNET terminals in all of its county Extension offices. AGNET staff are located in each of the full partner states of Montana, Nebraska, North and South Dakota, Washington and Wyoming. Further information may be obtained by contacting David G. Rice, AGNET Manager, North Dakota State University, P.O. Box 5437, Fargo, North Dakota 58105. Phone (701) 237-7381.

CROPPAK can be used to generate and analyze selected crop production components and can include an economic analysis. It presently does this for wheat, durum, barley, oats and sunflower. The CROPPAK model predicts potential yields based on the amount of water available for crop growth. The water available for crop growth is based on stored soil water estimates and probabilities of receiving various amounts of precipitation.

II. MODEL DEVELOPMENT

The CROPPAK model has developed over time. It drew heavily on an AGNET program called FLEXCROP developed by Dr. Paul Kresge, Extension Soil Scientist, Montana State University, Bozeman, Montana and Dr. Ardell Halvorson, Soil Scientist, USDA, S&E, ARS, Sidney, Montana.[1] Refinements of and additions to FLEXCROP by North Dakota Cooperative Extension Service and Agricultural Experiment Station staff at North Dakota State University in Agricultural Economics, Agronomy, Entomology, Plant

Pathology and Soil Science were used to develop the current CROPPAK model.

CROPPAK is a computerized crop production and economic model which presently has the following subroutines:

A. SUBROUTINES

1. SOIL WATER - Calculates available water as determined by moist soil depth and soil texture.
2. CROP CHOICE - Finds information about a chosen crop and its varieties.
3. REGION - Determines which of the six CROPPAK regions that a given county is in.
4. YIELD - Calculates yield based on crop variety, stored soil water, precipitation, region, and the disease factor due to not rotating.
5. FERTILIZER - Gives fertilizer recommendations for 26 crops dependent upon crop yield goal and soil test levels. Gives effect on yield from your application levels of nitrogen, phosphorus and potassium.
6. INSECTS - Gives insect control information for your crop.
7. WEEDS - Gives weed control suggestions for your crop and shows effects your choices have on yield.
8. LATE SEEDING - Gives seeding date recommendation for crop and region, and effects on yield from late seeding.
9. TOTAL WATER - Calculates total water supply based on stored soil water and precipitation for the growing season.
10. PRECIPITATION - Determines probable precipitation for given time periods.
11. CROPPAK - Combines all of the above and concludes with an economic analysis.
12. ECONOMIC ANALYSIS - Variable costs per acre are determined and the return over these costs is calculated for the chosen crop.

These various subroutines can be used individually or in combinations. For example, someone interested in specific information on insects or fertilizer can go directly to these respective subroutines, or CROPPAK can be run using all subroutines to obtain an overall short run (one-year) financial plan.

The fertilizer subroutine presently contains fertilizer recommendation information for wheat, durum, rye, oat, malting and feed barley, flax, sunflower, sugarbeet, potato, soybean, pinto and navy bean, mustard, rapeseed, corn grain and silage, buckwheat, lentils, field pea, millet, canary seed, grass, safflower, alfalfa and sweet clover.

Numerous county Extension agents and external users are using the CROPPAK model to assist farmers and ranchers, ag lenders and bankers, farm managers and agricultural consulting firms to estimate yield potentials 4-9 months ahead of harvest and better determine production input decisions.

III. TEST OF MODEL (1981)

During the 1981 growing season the ability of the CROPPAK model to predict at seeding time what potential harvested wheat yields would be was tested at Minot and Williston on recrop (non-fallow) sites. The variables tested were:

1. Estimated stored soil water
2. Seeding date
3. Expected average growing season precipitation
4. Weed control
5. Disease control
6. Nitrogen fertilizer use based on soil nitrate-nitrogen to 24 inches
7. Variety selection (Coteau and Solar are hard red spring wheat varieties, Vic and Cando are durum spring wheat varieties)

Disease control did not affect yield performance at these sites. As a result the yield comparisons presented are an average of the two disease control treatments.

The variety, nitrogen fertilizer and weed control results for the sites are given in Table 1. Narrative comments regarding predicted versus actual performance of varieties tested in CROPPAK regions follows the tabular data.

Table 1. 1981 CROPPAK Model Test

Location/Variety	Williston	
Subroutine	Coteau	Solar
	(bushels per acre)	
Variety		
Predicted	28.0	32.3
Obtained	29.6	33.0
% Error	-5.7	-2.2
Fertilizer		
Predicted	29.4	33.9
Obtained	29.6	33.0
% Error	- .7	+2.7
Weed Control		
Predicted	15.1	16.8
Obtained	13.0	15.6
% Error	+13.9	+7.1
	Minot	
Subroutine	Vic	Cando
	(bushels per acre)	
Variety		
Predicted	30.6	31.2
Obtained	33.8	34.3
% Error	-10.5	-9.9
Fertilizer		
Predicted	31.7	32.3
Obtained	33.8	34.3
% Error	-6.6	-6.2
Weed Control		
Predicted	26.4	26.8
Obtained	27.7	31.8
% Error	-4.9	-18.7

A. VARIETY PERFORMANCE WITHIN CROPPAK REGION

Region 1 (Northwest). Croppak predicted Solar should yield 15 percent more than Coteau at Williston. The yields obtained showed Solar yielded 11.5 percent more than Coteau. Thus 15.0-11.5 = 3.5 percent less yield than projected.

Region 2 (Northcentral). At Minot CROPPAK predicted Cando would out yield Vic by 2 percent. Actual yields obtained were 31.2 bushels per acre for Cando and 30.6 bushels per acre for Vic.

B. SUMMARY

The CROPPAK model did quite well in 1981 in predicting harvested yields using seeding time inputs. Remember these inputs were used several months before harvest. The Williston site was seeded on 4/24/81, harvested on 8/12/81. The Minot site was seeded 5/13/81, harvested on 8/27/81. Weed infestation counts were made on 5/27/81 at Williston and 5/28/81 at Minot. The expected yield reductions due to weed infestation were based on equations contained in Montana's FLEXCROP model. The potential wheat yield equation used presently in CROPPAK also comes from FLEXCROP.

IV. REFERENCE

1. Kresge, P. O., and A. D. Halvorson. 1979. FLEXCROP User's Manual: Computer-assisted dryland crop management. Montana State University, Cooperative Extension Service Bulletin 1214, Bozeman, Montana.

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