Crop monitoring in central-western NSW

Catherine Evans[1], Rob Sanderson[1], Richard Maccallum[2] and Neil Fettell[2]

[1]Central West Farming Systems, PO Box 171, Condobolin, NSW 2877
catherine.evans@agric.nsw.gov.au
[2] NSW Agriculture, PO Box 300, Condobolin, NSW 2877

Abstract

Crop monitoring in central-western NSW has been adapted to suit farmers of the area, after finding that the small group model of Topcrop or the Check Approach was unsuccessful. Farmers in central-western NSW are willing to form groups to discuss results or research but are not willing to form small groups to collect information. Central West Farming Systems (CWFS), a farmer-driven research organisation, developed a system where farmers pay to enrol in a crop monitoring program. Monitors are employed, with the assistance of additional funding, to collect paddock measurements. Farmer involvement in data collection can be minimal. Results are collated and after each sampling period a report, summarising the information, is sent to each farmer along with their own results. In February of the following year, seminars are held in a number of areas across the region, where the year's results are discussed and trends or observations are highlighted. The program is a benchmarking exercise where farmers can compare their results with their neighbours.

However, the results of the crop monitoring program can be used in three ways - (i) to give a detailed picture of farming practices of the region, (ii) to allow farmers to compare their data between their own paddocks and paddocks of neighbours and (iii) to investigate relationships across the whole region. This paper gives a picture of farming practices across the region and uses examples of comparison between paddocks where the soil type, climate and farming practices were similar.

Key Words

wheat; yield; nitrogen; phosphorus; water use efficiency; co-learning

Introduction

Crop monitoring or checking, is based on the detailed measurement of farm paddocks or farms to identify the key factors which are linked to higher productivity, sustainability or profitability (1). This approach was first tested on irrigated wheat in 1984 and the principles have since been adapted to other industries and regions, particularly under the Topcrop program. The sharing of information both between farmers and with advisers and researchers is a key part of these programs (1).

Topcrop group activities have been less than successful in central-western NSW. The reasons for this are not clear but could include the large farm size (and hence distance between farms) and a reluctance to spend time in detailed monitoring of paddocks. Farmers, however, are keen to participate in discussion of crop monitoring results and research. Through Central West Farming Systems (CWFS) farmers have developed an alternative approach to crop monitoring.

CWFS is a farmer-driven research organisation based at Condobolin but covering central-western NSW. It has over 300 members in the area from Nyngan in the north to Griffith in the south, from the Newell Highway in the east to Euabalong and Nymagee in the west. The average annual rainfall varies across the region from 350 mm to over 600 mm of which about half falls in the April to October growing season.

The CWFS crop monitoring program commenced in 1999 using a group of volunteers to carry out field measurements on 76 paddocks using Topcrop cards. The program generated a large amount of interest amongst growers as a benchmarking exercise. CWFS therefore sought funding to develop their own card system, employ monitors and increase farmer numbers to encompass a wider cross section of the region.

Methods

The program was significantly increased in 2001. Farmers paid $50 to join the program which also received sponsorship from AWB Ltd and Farmbis support. CWFS employed 18 people to conduct the monitoring including a part-time coordinator. Over 90 farmers enrolled for the program, with most farmers opting to have 3 paddocks monitored, usually selecting paddocks with widely different rotation or management histories. Crop monitors work in their local area and most have an agricultural background. They undergo training for a day to explain the technicalities of the forms and the importance of accurate data collection.

In 2001, data were collected from over 250 paddocks, of which 185 were wheat, 35 canola, 30 barley, 8 lupin, 4 oat, 4 field pea, 1 triticale and 1 chickpea. Data were collected at four crop stages; by the employed monitor three times (after emergence, mid-late tillering, grain filling) and once (at harvest) by the farmer faxing harvest information to the coordinator. After each data collection period, a report summarising regional data together with their own results was sent to farmers. In February 2002, four seminars were held across central western NSW, with most of the participating farmers attending.

The results from the program are used in three ways. Firstly, the results give a detailed picture of the farming practices of the region. This has proved invaluable in understanding farming systems and formulating research proposals. Secondly, farmers in each sub-region can compare their own paddocks with those of neighbours, usually with similar soil types and seasonal conditions. This occurs both informally and at the February seminars. In each sub-region there are usually sufficient paddocks to measure the links between yield and management practices such as sowing date, crop sequence, plant density and fertiliser rate. The third use is to investigate relationships across the whole region. This greatly increases the size of the data set and so the effects of such things as rainfall, tillage system, machinery type and row spacing can be measured. However, some of these effects are likely to be confounded by regional differences in soil type, climate and farming practices. In this paper only the wheat crops are discussed and basic linear regression, ranges and means are given.

Results and Discussion

Crop sequence varied widely across the paddocks. The most common sequence was wheat after wheat (35% of wheat crops) followed by wheat after fallow (25%) and wheat after pasture (15%). Fallow length is commonly about nine months and it is likely that pasture preceded fallow in most paddocks. 13% of wheat crops followed canola and 10% followed legume crops. This use of "break" crops is similar to findings in other low rainfall areas (2).

The most popular wheat varieties grown were Janz (23%), Cunningham (18%), H45 (15%) and Sunstate (8%) but 15 varieties were represented. Prime Hard varieties were sown in 67% of paddocks including many wheat after wheat paddocks where high protein grain is unlikely. Sowing date ranged from 18th April to 3rd July with the average being 23rd May. About 25% were sown to longer season varieties (recommended sowing before mid-May). There was no relationship between sowing date and yield. Row spacing ranged from 12.7 cm to 33.0 cm with the average being 20.3 cm. Average sowing depth was 5 cm with no paddocks sown below 10 cm. The most commonly used covering devices were harrows (50%), prickle chains (39%) and press wheels (11%). Most farmers applied 2 herbicides in the season but a few farmers applied no herbicides. The maximum was 5 herbicide applications. Harvest date ranged from 3rd November to 27th December with the average being 19th November. Ranges and means for some of the other parameters are given in Table 1.

Table 1: Mean and range for some of the parameters collected for wheat crops in the 2001 Crop Monitoring Program

Sowing rate	Applied N	Applied P	Plants/m^2	Tillers/m^2	Grains/head	Yield	Protein (%)	Screen-ings	2001 Rainfal

	(kg/ha)	(kg/ha)	(kg/ha)				(t/ha)			l (mm)
mean	40.9	16.1	14.4	85.9	306.5	42.1	2.02	12.4	2.06	302.7
min	20	0	8.8	30	93	16.8	0.45	8.5	0.2	187
max	65	62	32.9	145	624	68.4	3.87	17.0	9.5	458.5

Examining the relationships between the 2001 rainfall, wheat grain yield and wheat grain protein produces interesting outliers (Figure 1). The different practices that may have produced these outliers are discussed below.

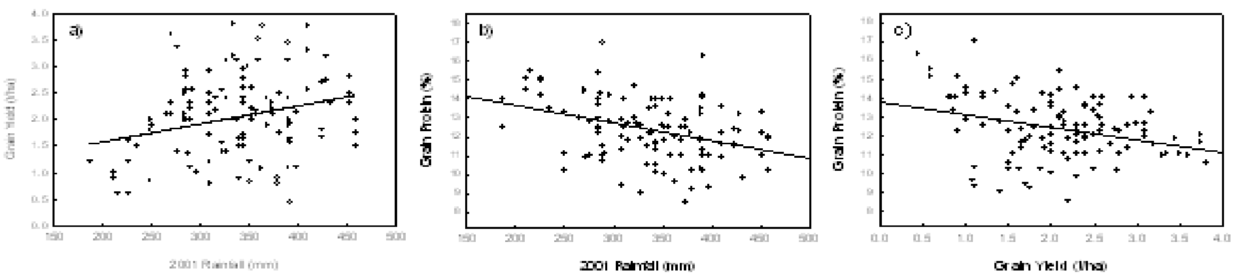

Figure 1: Graphs showing data and linear regression relationships between a) 2001 rainfall and grain yield, b) 2001 rainfall and grain protein and c) grain yield and grain protein

In Figure 1a, the group of outliers above the regression line (white filled circles) represents those wheat crops with high yield at a given rainfall. The difference between each of those crops and crops grown by the same farmer in different paddocks is that these high yielding crops had more tillers/m^2 and more grains/head. In most cases there were similar paddock histories, similar rates of fertiliser used with slightly lower yields in the other paddocks from the same farmer.

The group of outliers to the bottom right of the regression line (grey filled circles) represents those crops where between 300 and 400 mm rainfall fell in the year yet crop yield was less than 1 t/ha. There are a variety of explanations to explain these outliers. In one case there was frost damage, reducing yield. In another case, no nitrogen fertiliser was applied and this paddock had no legumes grown in the last 7 years, so low nitrogen limited yield. In some cases plant, or tiller, death occurred before October as plant density and/or number of tillers/m^2 was greater than the number of heads/m^2 in October. Low rainfall in August and September was the possible cause. Another crop had high protein compensating for the low yield, and another followed a high yielding, high protein crop, which may help to explain the low yield.

In Figure 1b there are two outliers to the top of the regression line (grey filled circles) that have very high protein at a given rainfall. One point is a frost-damaged crop that had 32 kg/ha nitrogen fertiliser applied. The other was a Hartog wheat crop (prime hard variety) with low plant density, tillers/m^2 and average grains/head. With the lower yield of both these crops, nitrogen would have been used for grain fill, increasing protein.

In Figure 1c, those outliers along the bottom (grey filled circles) with yields between 1.0 - 2.25 t/ha but grain protein <10% all had less than average nitrogen fertiliser application and poor, or no, legumes grown previously. So nitrogen limitation would explain these crop results.

Rainfall varied across the crop monitoring sites from 187 to 458.5 mm (Table 1). Water use efficiency (WUE) of the crops varied from 2.7 to 25.5 kg/ha/mm with the average being 13.52 kg/ha/mm, calculated using the traditional French and Schultz (3) model. Using the Cornish and Murray (4) model, that arguably has more application in this equi seasonal rainfall region, WUE ranged from 2.4 to 20.8 kg/ha/mm, with the average being 11.22 kg/ha/mm.

Figure 2 shows the relationship between crop available water (fallow storage and growing season rainfall) and grain yield. A typical value for WUE for grain is 10 kg/ha/mm (4) and a maximum is 20 kg/ha/mm (3). Figure 2a gives the 10 and 20 kg/ha/mm WUE lines calculated by the French and Schultz (3) method. Figure 2b gives the same WUE lines calculated by the Cornish and Murray (4) method with a regression line fitted through the data points. Both figures show that there are many crops not achieving their water-limited potential, so other factors must be affecting crop yields. In some instances nitrogen nutrition is a major limitation. In these cases there was little or no use of legumes and only small amounts of nitrogen fertiliser applied. In other cases tiller density decreased between early flowering and late October due to moisture stress. The crop with the lowest yield was frost damaged. The crops with a WUE of about 20 kg/ha/mm (Figure 2b) had average nitrogen nutrition (one was topdressed after a light application at sowing) and had grown a grain legume in the past 3 years and both had 11% protein with their high yield. There seemed to be no other common factors between the two crops and nothing obviously different to all other crops.

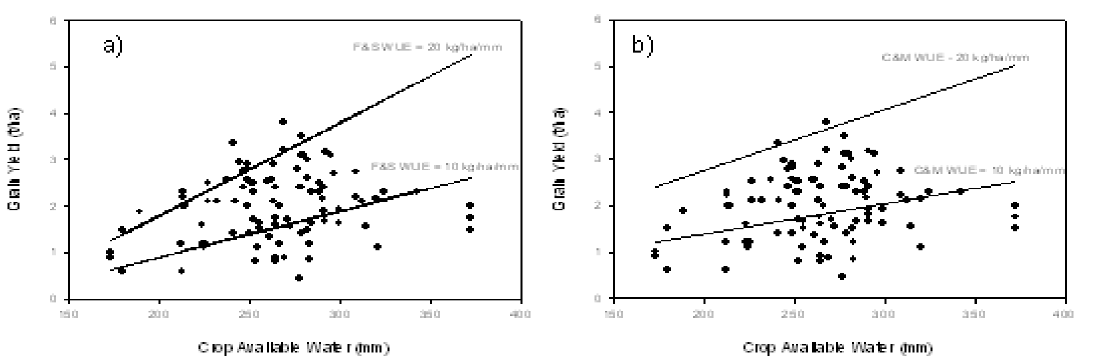

Figure 2: Graphs showing the relationship between crop available water (fallow storage + growing season rainfall) and grain yield. The 10 kg/ha/mm and 20 kg/ha/mm water use efficiency lines are shown, as calculated by the a) French and Schultz method and b) Cornish and Murray method.

There was no relationship between 2001 rainfall and the amount of applied fertiliser. Most of the phosphorus applied was between 8 and 22 kg P/ha. The nitrogen applied ranged between 5 and 45 kg N/ha. There was no relationship between nitrogen and phosphorus fertilisers applied and yield nor between nitrogen applied and grain protein. Sulphur application was low (<7 kg S/ha) for most farmers but a few farmers applied up to 60 kg S/ha generally in the form of sulphate of ammonia. There was no relationship between sulphur application and yield.

One of the assumptions made was that the rainfall reported by the farmer was that which the crop received. In fact the rainfall is usually measured at one place on the property and rainfall can vary from paddock to paddock. Although the data compared yield with rainfall it is only a property rainfall not necessarily the rainfall that the crop actually received.

There are some areas of the crop monitoring program that need to be improved. Some of the data collected relied on subjective assessments (e.g. evenness of establishment, weed evaluation, legume percentage in previous years as a ranking of 1-7). A standardised assessment for these measures would make the data less subjective and we hope to develop this over time.

Most of the farmers from 2001 have applied to join the program again in 2002. This implied that farmers were generally happy with the program. In 2002, 107 farmers have enrolled in the program (a 12% increase). In 2001 the farmers were not surveyed as to their thoughts on the program but the 2002 harvest card asks their thoughts. The fact that farmers are returning to the program and the enrolment numbers are increasing suggests that farmers find crop monitoring, in this format, useful.

Conclusion

Crop monitoring in this format has meant that farmers are using benchmarking, discussing crop performance and crop management and thinking about changing their management options. The seminars have generated discussion and encouraged farmer comments and input. This should help farmers move closer to their water-limited yield potential. The fact that farmers are returning to this program and that the number of paddocks monitored is increasing, implied that farmers were happy with this style of program as opposed to the unsuccessful small group approach.

References

(1) Lacy, J.M. (1998) 9th Australian Agronomy Conference, Wagga Wagga, NSW.

(2) Sadras, V., Roget, D. and O'Leary, G. (2002) Aust. J. Agric. Res., 53: 587-598.

(3) French, R.J. and Schulz, J.E. (1984) Aust. J. Agric. Res., 35: 743-764.

(4) Cornish, P.S. and Murray, G.M. (1989) Aust. J. Exper. Agric., 29: 77-83.