FINAL REPORT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

AGG00002

Growing high yielding crops on sandy soils

PROJECT DETAILS

PROJECT CODE:	AGG00002
PROJECT TITLE:	GROWING HIGH YIELDING CROPS ON SANDY SOILS
START DATE:	01.03.2015
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Summary

Sandy soils and sandy rises attribute up to 30% of the cropping soils west of Griffith, New South Wales (NSW). This amounts to hundreds of thousands of hectares of cropping area in this region. Similar sands are also common on many mallee type soils found in southern NSW, Victoria (VIC) and South Australia (SA).
Over the past 10 or so years, it has been apparent that these sandy soil types are under-performing in no-till farming systems. No-till farming systems have been vital to minimise soil erosion on these soil types, but unfortunately rely on agronomy techniques that are not suitable for sands.
It is not uncommon to have full moisture profiles on sandy soils under crops at harvest that are only yielding 1t/ha. This is poor use of a most limited resource (moisture), which also has a doubling effect as weeds during the fallow grow vigorously on the unused stored soil water.
There are many theories why sandy soils are underperforming in this environment, and Ag Grow Agronomy has already undertaken field trials and highlighted management techniques which foster high yields under these situations.
This project aimed to evaluate various agronomic techniques that have been identified to have negative outcomes on sandy soils.
Following the project, it is hoped that there is a better understanding of management practices that foster healthy crop growth and in turn increased yields on these fragile soils.
This will, therefore, allow successful no-till farming systems to be maintained on these fragile soils, lowering wind erosion and significantly increasing crop production.

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Conclusions

The results and conclusions from the four key trials on management practices to maximise profitability and sustainability on sandy soils in south western (SW) NSW include:

1. Cultivation, ripping and spading: Trials in 2015 showed the value of cultivation, especially when it was coupled with manure or to a lesser extent lime. Results showed that adding a deep cultivation (20-30cm) increased yield by approx. 1t/ha. Deep ripping to 50-60cm gave no extra yield benefit. Adding 3t/ha lime and incorporating with a deep cultivation increased yields by an additional 1.6t/ha compared to the Control, but adding 3t/ha chicken manure and incorporating with a deep cultivation gave the highest yields, with yields 3.1t/ha above the Control.

2. Nutrition: In this trial, monoammonium phosphate (MAP) was applied with the seed, however all other treatments were either pre-drilled just prior to sowing or spread and incorporated by sowing (IBS) (manure). This trial highlighted the sensitivity to higher rates of MAP with the seed, as a result of crop burn, which is commonly observed on sands. It also highlighted the value of applying nitrogen (N) and phosphorus (P) in conjunction with each, with 50kg/ha MAP increasing yields by more than 1t/ha and 50kg/ha MAP plus 50kg/ha urea increasing yield by more than 1.5t/ha. This was also seen with normalised difference vegetation index (NDVI) - generally the higher the NDVI at flowering, the higher the yield. There was no benefit of applying either sulphur (S), potassium (K) or zinc (Zn) in this trial. Manure was again a standout treatment, which would likely offer several years of increased yields. Yields in this trial were limited by an extremely dry finish to the season.

3. Variety and seeding rates: There is a major difference between varietal performance on sands. This is partly as a result of acid soil tolerance. The wheat variety, Bellaroi(Φ) is not tolerant of acidity, and as such performed very poorly. Suntop(Φ) wheat rates as moderately tolerant, however it was a standout performer in this trial. The higher rated acid tolerant wheat varieties Corack(Φ), Ventura(Φ) and EGA Gregory(Φ) performed well, however, were well behind Suntop. All barley varieties (which are not usually tolerant of acid soils) performed exceptionally well. In this trial, yield increased consistently as seeding rate increased, with the highest seeding rates of 150kg/ha, yielding best. Suntop at the sowing rate used typically for heavier soils, 40kg/ha, yielded 3.2t/ha. At a lighter sowing rate of 20kg/ha, it yielded 2.8t/ha, and for higher sowing rates of 60kg,100kg and 150kg/ha yielded 3.6t, 3.9t and 4.2t/ha, respectively.

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4. Influence of herbicides on sands: Some pre-emergent herbicides did have an impact on grain yield. 2L TriflurX®#, Boxer Gold®# at 2.5L IBS and Boxer Gold® at 1.5L early post-emergence (EPE) all reduced yields in this trial. This is commonly observed commercially and fits within expected results. Logran®# unexpectedly had very little effect on yield. This is not the case with commercial observations, and as such, this product is normally avoided on sands. Another important outcome of the research was the sensitivity of the sands to residual effects of fallow herbicides, glyphosate# and 2,4-D#. These products were used at higher than label rates to test the concept that these products can be quite damaging to crop growth and yield on sands. This proved to be true, and whilst these results are due to a practice not recommended, this needs further investigation.

Recommendations

Cultivation, soil nutrition, variety choice, soil acidity and herbicide choice have been identified as key factors in improving crop performance and overall profitability on sandy soils on many farms in SW NSW.

The recommendations and take home messages, addressing these issues and growing successful crops on sandy soils, from the trials (both small plot and commercial demonstrations) and local grower experience include:

- Carefully planning crop rotations, taking a holistic approach to getting the best out of sandy soils. It is important to plan to maximise crop biomass on sands and maximise soil cover.
- Grow crop types and varieties that perform well on sands, including wheat, barley, lupins and field peas. Try to avoid 18 month fallows on these soil types.
- Consider utilising variable rate technology (VRT) in seeders and spreaders to minimise input costs and maximise profitability. The savings and benefits are significant. Yields can be improved by up to 30% by adopting VRT, as sandy parts of the paddock require different agronomy such as seed and fertiliser rates compared to the more typical soil types in the paddock.
- Use higher seeding rates with cereals on sands compared to heavier soils. The effect of higher seeding rates in other crops is unknown.
- Be careful with seed burn when using starter fertilisers such as MAP and diammonium phosphate (DAP) at rates more than 50kg/ha.
- Nutrition is very important on sands. Consider topdressing urea early in the season at rates over double those required on heavier soils.
- In areas where manures are available, apply manure on your sands for an expected three year benefit.
- Plan the use of pre-emergent and knockdown herbicides carefully. Some products are very risky to use on sands, as sandy soils are sensitive to the residual effects of some herbicides.
- Cultivation on sands should be considered carefully. Cultivation in some cases can increase yield, however the benefits can be quickly outweighed by increased erosion risks and poor crop establishment due to sand blasting.

Achievements/Benefits

Sandy soils are typically classified as having greater than 75% coarse particles (sand) in their texture. Many sands in SW NSW exhibit both fine and coarse sand particles, in addition to very fine silt particles that often concentrate between larger sand particles and on top of compaction layers.These sands are found commonly on mallee country, and are very rarely evenly spread across a paddock. This is because of the way they were originally formed during historic wind erosion events.

Sandy soils are scattered right throughout the SW NSW cropping belt, however they are very common between Ardlethan in the east and Cobar in the north west, and in this area can contribute up to 30% of the cropping landscape. Sandy soils continually under-perform in this region, and while these soils are mainly regarded as poor for cropping, research suggests they can be more than profitable.

Over the past 15-20 years, there has been a lot of effort researching better ways to grow crops on sands. In recent years, Ag Grow Agronomy, along with many clients, has undertaken more formal research evaluating various management factors that impact on crop performance on sandy soils. This has led to four main management factors that have been identified that make a difference to crop performance. Trials in 2015 were designed around these factors.

The management practices to maximise profitability and sustainability on sandy soils in SW NSW include:

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1. Cultivation: Over the past 20 years the farming system has moved quickly to a zero or no-till system, where cultivation has been either eliminated or minimised. Adoption has been rapid on sands in order to reduce erosion.
Many trials have evaluated the place for various forms of cultivation, including deep ripping with narrow points (leaving stubble intact), deep ripping to 50cm, full cultivation, and spading. It has been shown that any disturbance of the silty sub-layer at 12-15cm by ripping and cultivation often results in an increase in crop performance, however it is not without its downside. The major hurdle is sand blasting of the following crop, resulting in poor crop establishment, uneven soil finish, and wind and water erosion. In 2015, a trial was designed to investigate the effect of various forms of cultivation on sandy soil with and without the addition of manure and lime.

2. Nutrition: Sands are less fertile and therefore require more fertiliser for productive crop performance, with N and P fertilisers very important. There are also benefits in adding manures and lime to sandy soils. A trial was established in 2015 to evaluate and compare the effects of various N, P and S rates, as well as with and without Zn and manure on wheat yield and quality on sandy soil.

3. Variety and seeding rate: Seeding rates have been evaluated commercially for a few years using grower equipment, and there is a general agreement that NDVI and consequently yield increase with higher seeding rates. There are also major differences between varietal performance on sands, partly due to acidity tolerance. In 2015, a trial was established specifically on sand to evaluate varietal performance in the region, as well as the effect of increasing seeding rates. Varieties used in the trial were chosen based on their acid soil tolerance.

4. Herbicide: Using herbicides on sandy soils has many issues. This is because sands are very low in microbial activity, reducing their ability to break down herbicide residues, they are free draining allowing herbicides to enter the root zone of plants, and they are often sprayed regularly as a result of the way weeds germinate on minimal moisture. A trial in 2015 measured the effect of various knockdown and pre-emergent herbicides on NDVI and yield on a sandy soil.

The results from the trials conducted in 2015, along with previous research and large scale trials conducted in the area, were all collated and used to produce the best management practice (BMP) guide titled 'Growing profitable crops on sandy soils in SW NSW - 'A guideline collating recent research outcomes and management practices for profitable cropping systems on sandy soils'.

Other research

This project has steered the way for direction for a further sandy soils project which has now been funded.

Additional information

Attachments

Publication - Growing profitable crops on sandy soils in SW NSW.

GRDC Research Update paper Wagga Wagga 2016.

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