

**A GUIDE TO IMPROVING**

**PLANT ESTABLISHMENT**

**and**

**ROOT DEVELOPMENT**

**in**

**SUMMER CROPS**



THIS BOOKLET IS BASED ON PAPERS PRESENTED AT TWO PLANT ESTABLISHMENT SEMINARS CONDUCTED AT EMERALD AND MOURA IN AUGUST, 1980.

Speakers at these two seminars were:-

E. Boyce	Morris Machinery	B. Radford	Q.W.R.I.
S. Coaker	Farmer	D. Sawley	Farmer
R. Holmes	Farmer	G. Spackman	D.P.I.
I. Horneman	Farmer	G. Sullivan	Farmer
M. Hunter	D.P.I.	J. Tomlinson	Farmer
P. Lund	Farmer	J. Wood	Farmer
J. Mayne	Farmer	<u>Chairman</u>	
M. Middleton	Farmer	G. Coles	Q.G.G.A.
R. O'Grady	C.F.L.	J. Twyford	Q.G.G.A.
R. Otto	Farmer	J. Cutler	D.P.I.

Sponsors were Pacific Seeds and the Q.G.G.A. with the D.P.I. supplying technical and planning support.

The compiling of this booklet was undertaken by J. Slatter (Pacific Seeds) and J. Cutler (D.P.I.) with editing assistance from D.P.I. staff C. Paul, R. Jubb, G. Spackman, Local farmers W. McDonald, D. Sawley, J. Tomlinson and P. Murphy Pacific Seeds.

The contents are therefore not necessarily the personal opinions of the individuals of the editing group.

#### PUBLICATION

The tremendous contribution of the Queensland Graingrowers Association's printing department in the production of this booklet is gratefully acknowledged. The Q.G.G.A. provided their labour and printing facilities with layout, typing and materials supplied by Pacific Seeds.

# INDEX

---

## PLANT ESTABLISHMENT

---

INTRODUCTION:	Page 1.
ASSESSING YOUR PLANT POPULATION	Page 1.
FERTILIZER AT PLANTING	Page 2.
WEED CONTROL	Page 2.
PLANTING MOISTURE	Page 2.
SOIL CRUSTING	Page 2.
PLANTERS:	
COMBINES	Page 3.
AIR SEEDERS	Page 3.
UNIT PLANTERS	Page 3.
SOIL OPENERS / PLANTING POINTS	Page 4.
IMPROVING PLANTER OPERATIONS:	
PRESS WHEELS	Page 4.
PLANTING SPEED	Page 5.
ADEQUATE SOIL COVERAGE OF THE SEED	Page 5.
SOIL GLAZING OF THE PLANTING FOOT	Page 6.
PLANTING DEPTH	Page 6.
SEED TREATMENTS:	
PLANTING SEED	Page 6.
SOIL INSECTS	Page 6.
WATER TREATMENT OF SEED	Page 7.
WATER INJECTION	Page 7.
REDUCED TILLAGE TECHNIQUES	Page 7.

# INDEX

---

## ROOT DEVELOPMENT

---

INTRODUCTION:	Page 8.
POSSIBLE REASONS FOR RESTRICTIVE LAYER:	Page 8.
WORKING SOIL TOO WET	Page 8.
LONG FALLOW	Page 8.
GRAZING WITH CATTLE	Page 8.
WORKING SOIL TOO DRY	Page 8.
MARGINAL PLANTING MOISTURE	Page 8.
POSSIBLE SOLUTIONS:	Page 9
REDUCED TILLAGE	Page 9.
ADVANTAGES	Page 9.
DISADVANTAGES	Page 9.
OTHER SOLUTIONS	Page 9.
DON'T PLANT	Page 9.
DON'T GRAZE STUBBLE	Page 9.
DEEP RIPPING	Page 9.
VARYING CULTIVATION DEPTH AND TYPE	Page 9.
MORE EFFICIENT PLANTING	Page 9.

## AIM OF THIS BOOKLET

---

This booklet aims only to look closely at problems encountered, and possible solutions, that effect plant establishment at planting time and the resultant early root development.

It does not take into effect the many other factors in growing summer crops such as cultivation machinery, crop rotation, crop selections, variety selection, soil nutrition, weed and insect control and other general management issues.

Therefore the contents are to be used, in conjunction with normal good farming practices, as a guide to better plant establishment and initial root development in Sorghum and Sunflower.

The contents are by necessity brief, and further information is available by contacting your nearest office of the D.P.I., Q.G.G.A., or Pacific Seeds.

## PLANT ESTABLISHMENT

---

### INTRODUCTION

The end result of any crop is very much dependent on the successful and uniform establishment of the seed planted. Unfortunately in this area too many plantings result in complete or partial failures. A survey conducted by Emerald D.P.I. staff substantiates this experience by showing an average establishment percentage for Sorghum of 51% and Sunflower 40%.

By more careful attention to planting machinery, techniques and planting times significant improvements can be readily made. The result will give more reliable plant stands and consistent plant populations as well as savings in initial seed costs and avoiding costly replantings.

Before considering the main points raised by the many speakers we must first know what we plan to achieve as a plant population.

### ASSESSING YOUR PLANT POPULATION

There are two stages:-

- a) Calculation of seed planting rates.
- b) Count the plants established.

#### a) Calculation of Planting Rates

Use this formula to calculate your sowing rate:-

$$\frac{\text{Plant Population Required (plants/Ha.)} \times 100 \times 100}{\text{Seeds 1 Kg.} \times \text{Germination} \times \text{Establishment Factor}} = \text{Kgs. of Seed per Hectare}$$

#### (1) Population required:-

	<b>Central Highlands</b>	<b>Callide-Dawson</b>
Sorghum	50-75,000 plants/Ha. (Mean 65,000)	65-90,000 plants/Ha. (Mean 75,000)
Sunflower	30-40,000 plants/Ha.	30-40,000 plants/Ha.

As these crops are planted at low populations, uniform distribution of the plants within the row is relatively important to ensure full moisture utilisation.

- (2) Seeds per Kg. - Printed on the bag.
- (3) Germination % - Supplier should be able to supply or in some cases will be on the bag.
- (4) Establishment Factor - Soil type and soil moisture at sowing will be the two main considerations.

The following table will serve as a guide:-

Clay Soils	Good Moisture		Marginal Moisture	
	Sorghum	Sunflower	Sorghum	Sunflower
	60	50	50	40
Scrub/Alluvial Soils	75	60	60	50

For further discussion contact your nearest D.P.I., Q.G.G.A. or Pacific Seeds office.

(These guideline figures assume all other factors such as planting depth, insect activity, heat etc. are average).

IT IS IMPORTANT FOR EACH GROWER TO WORK OUT HIS OWN ESTABLISHMENT FACTOR.

### b) Count the Plants Established

Once the stand is established do a plant count to determine the actual plant population achieved. This will supply information for future sowings and indicate any other problems in soil conditions or planting technique.

A simple chart for counting plant stands:-

METRIC			IMPERIAL		
Row Width cms.	No. of Metres to count		Row Width inches	No. of Feet to count	
18	55		7	75	
35	27	X 1000	14	37	X 1000
53	19		21	25	
60	16	= plants per	24	22	= plants per
75	13	hectare	30	17	acre
90	11		36	15	
100	10		40	13	

Count number of plants in required distance randomly at least five times and average to ensure accuracy.

## FERTILIZER AT PLANTING

### 1. Nitrogen

Maximum rates of Nitrogen fertilizer when drilled with Seed:-

Row Spacing		Urea Kg./Ha.	Cropking 700 Kg./Ha.	DAP Kg./Ha.	MAP Kg./Ha.
cm.	ins.				
18	7	43	60	105	162
36	14	22	30	52	81
53	21	14	20	35	54
70	28	11	15	26	40
90	35	9	12	21	32

(Note These rates should be reduced by half for very sandy soils and increased by 30% for heavy clay soils.)

2. Phosphate It is questionable whether phosphate should be drilled in with the seed. However D.P.I. trials are currently being conducted and this information is available by contacting your local D.P.I. office.

### WEED CONTROL

If the planter does the dual role of weed control and planting seed then modifications (see planter section), to ensure more accurate placement of the seed into moist soil, are necessary for best results.

### PLANTING MOISTURE

Successful plant establishment relies on the seed being in firm contact with moist soil. If clay soils are planted too soon after the rain seed may not be adequately covered (refer section covering seed with soil). Also sowing too deep in wet clay soils can result in failure. The longer the period planting occurs after rain the greater the need to plant deep for moist soil contact (refer planting depth).

### SOIL CRUSTING

In many situations crusting cannot be avoided following a storm immediately after planting.

However the following considerations may reduce the effect.

- \* Break up compaction left by a press wheel (refer Press Wheel Section).
- \* Retention of surface stubble.
- \* Try heavy harrows to break crust before seedling emergence.
- \* Avoid overworking of light soils.

## PLANTERS

COMBINES In the past this has been the most common planter which can do a satisfactory job with Sorghum and a reasonable job with Sunflower if the following principles and modifications are adopted.

### Suggested Modifications

- \* Use a narrow point on the planting tynes, to better ensure seed is placed in a moist groove.
- \* Adjust the tension on the planting tyne as tight as possible to give it more rigidity therefore maintaining a more even planting depth. - stop layback.
- \* Use (70-90cm.) row spacings. This in effect means the metering drive is moving faster and a more uniform seed drop results.
- \* For Sunflower carefully check to see which seed size is most accurately dropped by the metering device. Select a seed size which is not damaged by the mechanism, but at the same time no more than two seeds are dropped at any one time. i.e. ensure a uniform flow of seed.
- \* Fit press wheels. This is particularly important because by the action of the combine tynes there is usually a mixture of dry and wet soil around the seed. (see section on press wheels).
- \* Do not plant in wheel tracks.
- \* Use smooth (plastic) delivery tubes.

### Major Disadvantages

- \* Cannot handle stubble.
- \* Loss of soil moisture due to excessive soil disturbance.
- \* The seed is normally in contact with a mixture of wet - dry soil.

AIR SEEDERS Can be calibrated and set up to give superior distribution and seed placement than combines.

### Suggested Modifications / Application

- \* Plant in 70 - 90 cm. (28"-35") rows.
- \* If there are any cultivating tynes behind the planting tynes ensure that they do not throw soil over the planted row.
- \* Select the planting tynes on the back or second back row of tynes.
- \* Fit moisture seeking points and adjust to plant 1 - 2.5 cm. (approx. ½"-1") below the depth of the weed control tynes, thus ensuring placement of the seed into moist undisturbed soil.
- \* Two air hoses instead of one to each planting foot has often given a more uniform seed drop.
- \* Fit Press Wheels (refer section on press wheels).

### Major Disadvantage

- \* Variable planting depth as the planting tynes are not in line with the carriage wheels.

UNIT PLANTERS There are two basic classifications:-

- a) Manufactured unit - There are a range of commercial plate, plateless and vacuum type planters on the market which can do an excellent job. Careful selection from this range to suit individual conditions is essential especially in regard to broadacre farming where robust construction is a must.
- b) Farmer built units - where the farmer purchases unit planting boxes to make his own planter, advantages:-

For Further Discussion contact your nearest D.P.I., Q.G.G.A., or Pacific Seeds Office.

- \* They can be fitted to a range of machines including scarifiers, combines, wideline cultivators, tool bars etc.
- \* Low cost compared to the manufactured unit planter.
- \* Improvement in metering performance over the combine type mechanism.

IMPORTANT NOTE The use of the correct planting tyne is important to obtain the advantages of whatever type of unit planter box is used.

WHATEVER TYPE OF UNIT PLANTER IS MADE-UP OR PURCHASED IT IS CRITICAL TO ENSURE PROPER SETTING UP TO ACHIEVE GOOD PERFORMANCE.

### SOIL OPENERS / PLANTING POINTS

1. Narrow points normally give a better result than wide points because they:-
  - \* Less soil disturbance i.e. mixing of wet and dry soil.
  - \* More uniform planting depth due to less tyne layback.
  - \* A more definite moist groove is made for the seed. However only a percentage of seeds will fall into the groove unless the seed tube is close to the planting point.

(A metal tip welded onto standard tynes can also effect the same groove for the seed)
2. A scraper or wide tyne in front of the planting tyne to remove dry soil will enable planting into moist soil at the optimum depth.
3. Knife or disc openers standard on some planter units are not satisfactory on heavy clay soils as the clay quickly builds up around these openers. Therefore hoe (tyne) type openers are satisfactory for clay soils.

### PRESS WHEELS

Are essential for a good and uniform establishment of summer crops in most soil situations. There are 3 basic types of Press Wheels:-

#### A) OVER-CENTRE PRESS (inflatable or car tyres etc).



This type does an excellent job of firming the soil around the seed but leaves the soil surface very firm. This type of press wheel is, for safety and without modification, only suited to crumbly soils not prone to sealing off.

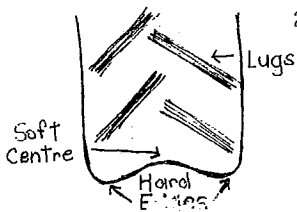
This has two disadvantages, particularly in clay or fine soils:-

- \* The top layer of soil is very compacted making it more difficult for seedlings to emerge, particularly Sunflower.
- \* The soil surface is left in a more potentially crusting situation, further aggravating emergence.

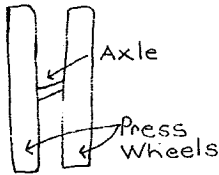
#### B) SIDE - PRESS



1. Narrow - approx. 10cm. (4"). The wheel is not wide enough to avoid compacting the soil above the seed and the same problems and application as for over-centre press wheels apply but to a lesser degree.



2. Wide - approx 20 cm. (8") or more. The hard outer edges compress the soil around the seed but the soft centre does not compact the soil surface. Small tractor type lugs are optional on many of these and are recommended as they have a further effect of breaking any compaction and leaving the soil surface rougher. Would be the number one choice for clay soils.

C) TWIN - INCLINED

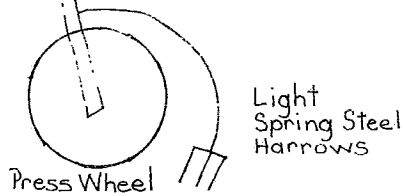
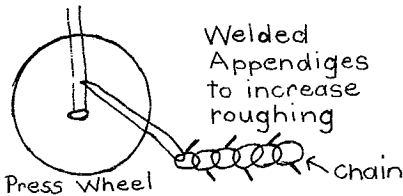
The press wheels compact the soil around the seed but leave the soil surface above the seed in a soft condition. In black downs or brigalow clay soils as they clog up with the soil, sticks get caught up or they are just not strong enough to handle the broadacre situation.

OVERCOMING THE PROBLEMS of Over-Centre Press Wheels and narrow side-press wheels.

AIM is to disturb the surface 1-2cm. (1/2"-3/4") therefore breaking up this compacted layer (which restricts emergence) and also reduces the likelihood of voluntary crusting.

Suggested Solutions

1. Behind each press wheel fit a chain or fixed spring harrow as illustrated.



2. Trailing light harrows - If moisture seeking tyres are being used they may drag too much soil over the row therefore burying the seed.
3. A chain covering the width of the planter to throw a little top soil over the press wheel tracks.

Note Both 2 and 3 should avoid crusting of the press wheel compaction but do not break up the surface barrier for the emerging seedling.

PLANTING SPEED

Whilst it is appreciated with large acres that speed of planting is important the consequences of planting too fast should be appreciated.

Recommended speed is 5 m.p.h. (8 Km./Hour) or less.

Excessive Speed Cause:-

- \* Greater likelihood of mixing wet and dry soil around the seed.
- \* Variable planting depth due to excessive machine movement and tyne layback thus varying the planting depth and reducing the capability of the tyne to penetrate a firm seed bed.
- \* Uneven seed distribution in some machines.

Remedy If it is essential to plant at above optimal speeds, seed placement and establishment will be adversely effected so planting rates should be raised to compensate. Alternatively, get a bigger machine or plant less area.

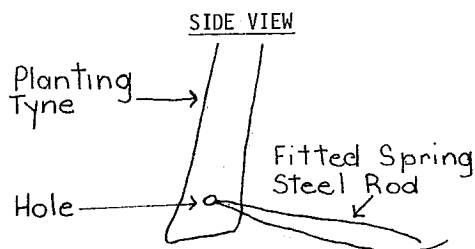
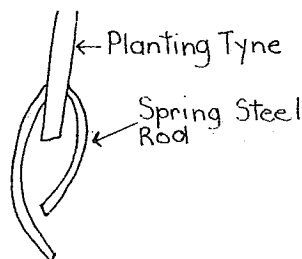
ADEQUATE SOIL COVERAGE OF THE SEED

One of the causes of patchy strikes is due to the planting groove not being filled with moist soil resulting in the seed being left in a drying situation and therefore will not germinate. This problem does not normally apply to the total paddock but to the wet spots within it. Therefore a contributing factor to many weak, low population areas within a paddock.

Solution

Attachment of spring rods to the planting tyne which operate on each side of the planting groove to disturb moist soil over the seed for the press wheel to press.

For further discussion contact your nearest D.P.I., Q.G.G.A., or Pacific Seeds Office.

BACK VIEW

Material e.g. 1cm. spring steel rod.

### SOIL GLAZING BY THE PLANTING FOOT

First let us define glazing. A glaze occurs when the planting foot compresses, smears, the soil around it as it moves through the soil and the soil retains the smooth hardened surface. A glaze is more likely to occur with a narrow and worn solid planting foot in a wet clay seed bed.

The major effect is not believed to be one of reducing emergence but restricting the downward penetration of the young root system therefore leaving the root trapped in the surface layer (refer section root development).

This problem has only been recently identified as a factor in reducing plant establishment and root development. It is believed to contribute to some of these problems:-

- \* Shallow root systems not utilizing sub-soil moisture.
- \* Seedling death.
- \* Retarded plants.
- \* Poor crop vigour.

### Suggested Remedies

- \* Do not plant heavy clay soils when they are too wet.
- \* Worn planting tynes tend to glaze more. Welding a wider piece of steel or tyne on the front of the point will help.

### PLANTING DEPTH

The optimum planting depth for both Sorghum and Sunflower is 5 cm. (2 inches).

Planting deeper will result in a lower establishment and can be corrected, mostly, by increased seeding rates. Preferably a scraper in front of the planting tyne to remove the dry soil on top will overcome the problem by maintaining the seed depth at 5 cm.

With SUNFLOWER SEED there are three (3) sizes, basically small, medium and large, and the larger seed with its increased food reserves can successfully germinate from a greater depth (up to 10 cm. (4" )).

World research has also shown that good small seed sown deep at increased sowing rates is as economical (remembering that seed size to suit the planter type is very important).

Planting seed deeper than optimum slows down the emergence and gives soil insects a greater opportunity to reduce the plant stand.

### PLANTING SEED

The main points here are:-

1. Correct variety for the conditions.
2. Know the germination of the seed so that planting rates can be adjusted accordingly.
3. In the case of Sunflowers, select the seed size best suited to your planter and planting conditions. Also check the rate when there is a change in batch number or variety due to the natural variations.

### SOIL INSECTS

The most common problem is False Wire Worm which is responsible for many patchy strikes. Whilst there is no perfect control method, treatment of the seed with Lorsban or Nabsol at 160 gm. per 100kg. of seed will give a degree of protection. As the cost is only a few cents per acre it is recommended that all seed be treated.

If the adult beetle is a problem some measure of control can be achieved by a baiting programme.

### WATER TREATMENT OF SEED

The advantages of water treatment are to speed up the germination and emergence of the seed, and to give a more uniform strike with the resultant advantage of the crop being more uniform at flowering and harvest.

The Two Systems used are:-

- a) SEED SOAKING - Where the seed is immersed in water and thoroughly wetted. The germination process is therefore started and the seed must be planted within 24 hours. The big disadvantage of course is that if planting is delayed any treated seed is rendered useless and must be discarded. This practice although tried has not been adopted in this area.
- b) SEED WETTING - A newer technique that has many advantages. The process only moistens the outside coat of the seed thus speeding up the germination process once the seed is in the soil. If planting is delayed the seed will store for 7 - 10 days thus avoiding costly seed losses. The technique has the advantage of speeding up plant establishment by 1 to 2 days and giving greater uniformity.

TECHNIQUE Add 1 litre of water to a 25kg bag of Sorghum seed (or a 15kg bag Sunflower seed) mix thoroughly and plant. Mixing of seed and water can be done in the bag or by using a concrete mixer etc.

Under good soil moisture conditions will possibly not warrant this technique but is well worth trying due to its advantage of quicker seedling emergence.

### WATER INJECTION

Whilst this practice has many merits it will certainly not overcome other deficiencies in planting technique. Attention to more basic problems of plant establishment should have a greater priority.

Work done on water injection suggests that there is no benefit when planting under good soil moisture conditions and the main advantage is to allow planting over a longer period. In other words an extra few days of planting with good results is indicated by research work. However the capital costs and logistics of the volume of water required on broadacre farming obviously poses big problems.

### REDUCED TILLAGE TECHNIQUES

The use of seed bed preparation techniques that require less cultivations and/or chemical weed control and the retention of surface stubble will assist in plant establishment by:-

- \* Retaining soil moisture at planting depth for a longer period thus increasing the strike percentage, especially towards the end of the planting programme.
- \* Keeping the top soil cooler which reduces heat stress on the germination seedling.

Conversely two factors which must be taken into account are:-

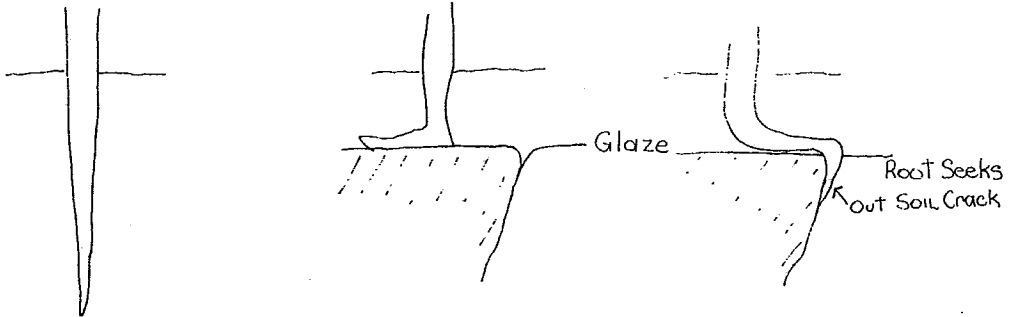
- \* The need for suitable planting equipment.
- \* Planting is delayed as the soil takes longer to dry down.

## ROOT DEVELOPMENT

### INTRODUCTION

Poor root development probably restricts sunflower yields in heavy clay soils more than anything else.

There may be good soil moisture reserves, but if the plant does not use them yields will be poor.



UNRESTRICTED ROOT

ROOT RESTRICTED

ROOT PARTIALLY RESTRICTED

Typically roots grow vertically to the cultivation depth and then grows horizontally until a crack or a softer area of subsoil is found. This restriction considerably restricts early growth. In many cases roots do not develop significantly below the cultivation level.

The severity of the problem depends on:-

- a) The evenness of emergence of the crop (the late emerging plants are usually affected much more than earlier plants).
- b) The speed of emergence.
- c) The depth and degree of restrictiveness of the impeding layer.
- d) The moisture content of the soil immediately below cultivation level.

Too many Sunflower crops are very uneven at maturity. Often the blame is attributed to poor genetically variable seed but on close examination the difference between the good plants and poor plants is nearly always root development.

### POSSIBLE REASONS FOR THE RESTRICTIVE LAYER

Most likely no single factor is responsible but more the cumulative effect of several factors.

Such as:-

1. Working Soil Too Wet - Heavy clay soils glaze readily when worked wet. Implements can seal off soil if used in wet conditions. Compaction is worse on wet soil.
2. Long Fallow - A large number of cultivations between crops is probably the major cause. Compaction caused by tractor wheels will increase with each operation. By planting time the topsoil is worked fine and shallow.
3. Grazing With Cattle - On wet soil cattle will cause severe compaction. Any grazing will contribute to compaction.
4. Working Soil Too Dry - Fine particles from dry worked soil move to the bottom of the cultivation level and contribute to the hard layer formation.
5. Marginal Planting Moisture - If surface moisture has only just met subsoil moisture or if planting moisture is nearly gone further drying may make the soil impenetrable to late germinating plants.

POSSIBLE SOLUTION

REDUCED TILLAGE - Cultivation systems variously known as Zero tillage, reduced tillage, minimum tillage, stubble mulching and trash farming, appear to have the most to offer towards reducing hard layer formation.

Reduced Tillage is the most appropriate title for the system as it is likely to be practiced in Central Queensland.

This system, as the name implies, aims to markedly reduce the number of mechanical operations while at the same time maintaining as much dead plant material as possible on the surface.

Growers from other areas who have been using various Reduced Tillage systems claim increased Sunflower yields.

Possible advantages from reduced tillage are:-

1. Less compaction caused by tractors and implements.
2. Moisture is kept closer to the surface under a mulch layer and roots can more easily penetrate soft moist soil.
3. Surface temperatures are reduced. This should aid seedling establishment in very hot weather and reduce evaporation losses at the surface.
4. Rain infiltration rate can be improved, particularly when compared to a finely worked long fallow.
5. Soil erosion losses can be significantly reduced.
6. Reduced cost.

Chemical prices are not rising as rapidly as fuel costs. This will make chemical cultivation more competitive in future.

Disadvantages

1. Many crops do not produce enough stubble for surface protection. Sunflower produces little stubble. There is little stubble with low yielding Sorghum and Wheat crops.
2. The broad range of weeds in many situations makes it necessary to use the more expensive chemicals to control weeds.
3. Efficient planting equipment, capable of successfully planting into a trashy seedbed is ESSENTIAL.
4. Soil insects, such as false wireworms, tend to be more prevalent in trashy conditions.

- \* -

Every farmer has something to gain from trying some Reduced Tillage practices on limited areas. Reduced Tillage is definitely the way farming is heading.

OTHER SOLUTIONS

1. DON'T PLANT - If after a thorough look, evidence of a hard layer can be found it may be best not to plant.
2. DON'T GRAZE STUBBLE.
3. DEEP RIPPING - Ripping deeper than normal cultivation has proved successful in irrigation areas, carried out at the right soil moisture content it will break up any hard layers and allow better water penetration. However very deep ripping is expensive and may not be economic under most broadacre dryland conditions. Use of chisel points working just below normal cultivation level has had apparent benefit on some local soil types. (However can the benefit be negated by later workings if soil too wet.)
4. VARYING CULTIVATION DEPTH AND TYPE - If two or more successive cultivations are carried out a precisely the same depth a compacted layer, however thin, will form. Every cultivation must be at a different depth. Some farmers have had better results with summer crops by working progressively deeper than by starting deep and working up.

The effect of the type of implement on compaction under the soil moisture conditions present should be considered and a less compacting alternative used if available.

5. MORE EFFICIENT PLANTING - A planting technique which will give rapid even germination will reduce the chances of later plants having more restricted root growth.

For further discussion contact your nearest D.P.I., Q.G.G.A., or Pacific Seeds office.