Interim report prepared by Michael Braunack, CSIRO Agriculture & Food
22 June 2016

Seedbed conditions and cotton establishment

Background

Poor crop establishment compromises productivity and may necessitate the expense of replanting. In cool regions, production can be limited by the need to replant due to prolonged cold conditions. There is limited information on seedbed conditions which enhance germination and emergence of cotton. Seedbed conditions need to be quantified with respect to aggregate size distribution in relation to seed size which is important for seed-soil contact. The type of planter in conjunction with soil moisture at planting can also affect the success of planting, both tynes and disc openers can cause compaction which may compromise root growth resulting in poor establishment due to increased soil borne disease incidence. Soil chemistry can also influence establishment due to high levels of sodium resulting in slaking/dispersion around the seed or seedling which harden on drying forming a surface crust preventing the cotyledon from emerging along with restricted root growth. Another issue being raised by growers is the poor establishment of some newer cultivars. Again seedbed conditions should be quantified in relation to the prior history of the field (fallow, wheat, legume, sorghum), soil moisture at the time of planting (planted on rain, planted dry and watered or watered and planted), the type of planter (disc or tynes, with or without press-wheels), planting depth and planting at varying speeds depending on the area to be planted aggregate size distribution of the seedbed and soil strength parameters. Another factor affecting establishment is the depth of planting in conjunction with cotton seed size. A range of soils should be assessed.

Objectives

- To define seedbed ranking system and its components.
- To develop objective tools and techniques to quantify field seedbed conditions across a range of soils.
- Develop a simple strategy to assist management decisions for planting.
- Provide training and extend information to industry.

Protocol

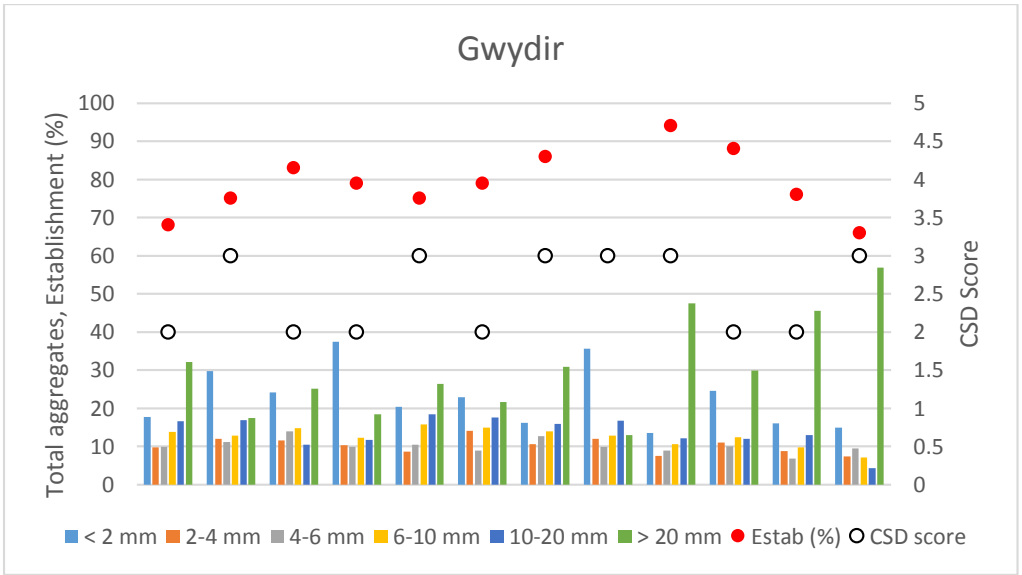
The project will examine seedbed conditions generated at planting across a range of soils in both irrigated and dryland systems to identify whether crop establishment varies by

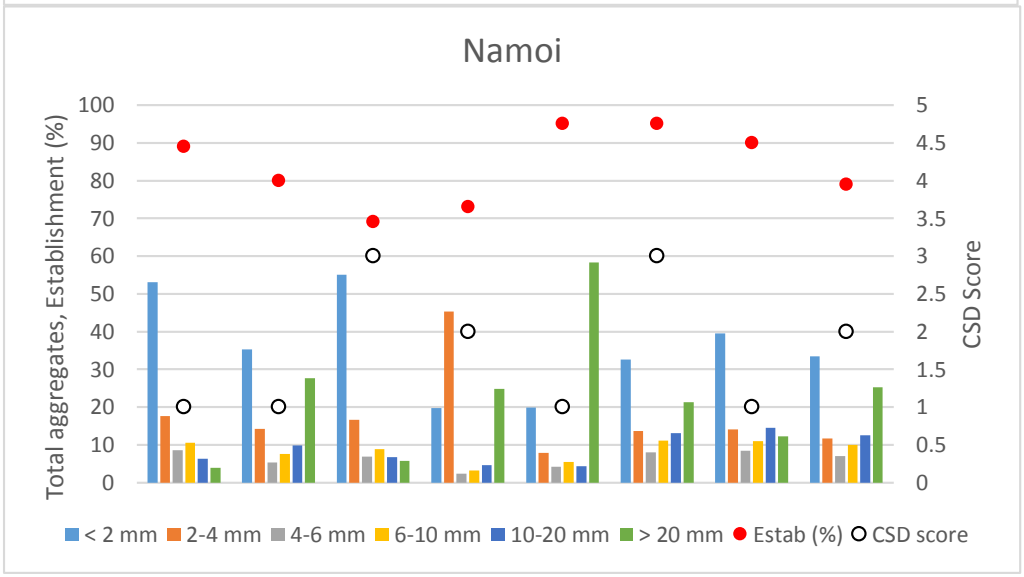
- Determining field history.
- Initial soil moisture at planting.
- Planting depth.
- Seedbeds will be assessed by determining the aggregate size distribution and trash levels in the seedbed.
- Surface crusting potential.
    - Slaking and dispersion.
- Soil compaction above and below the emerging seedlings and corresponding soil moisture
    - Using simple penetrometer.
- Soil borne disease.
- Establishment counts.

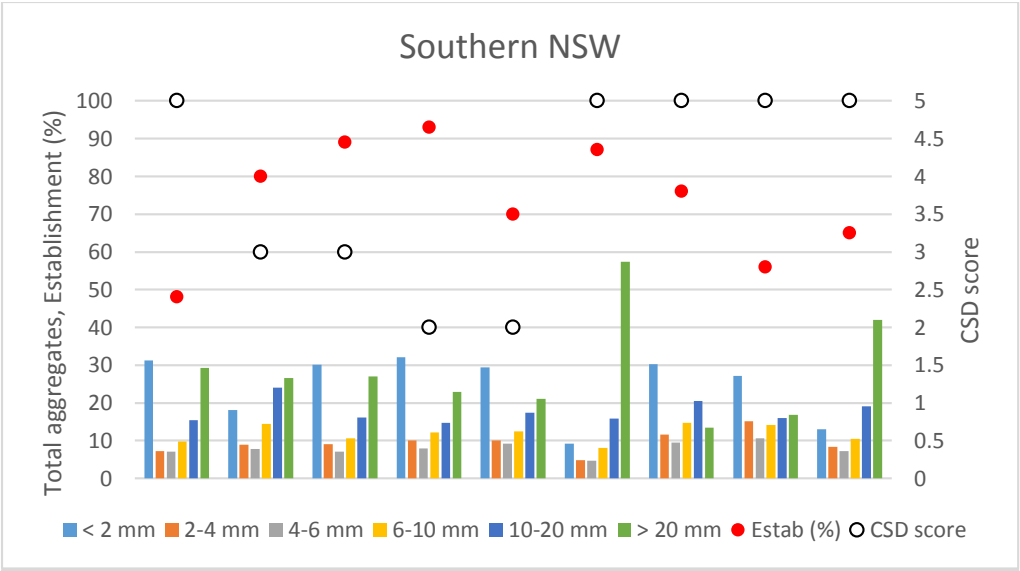
Preliminary Results

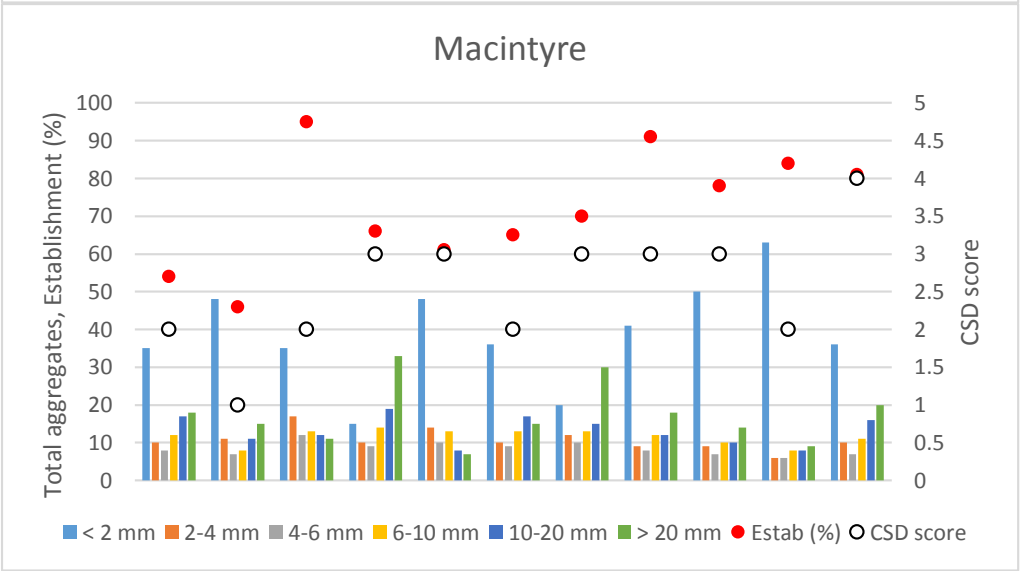
Establishment & subjective score

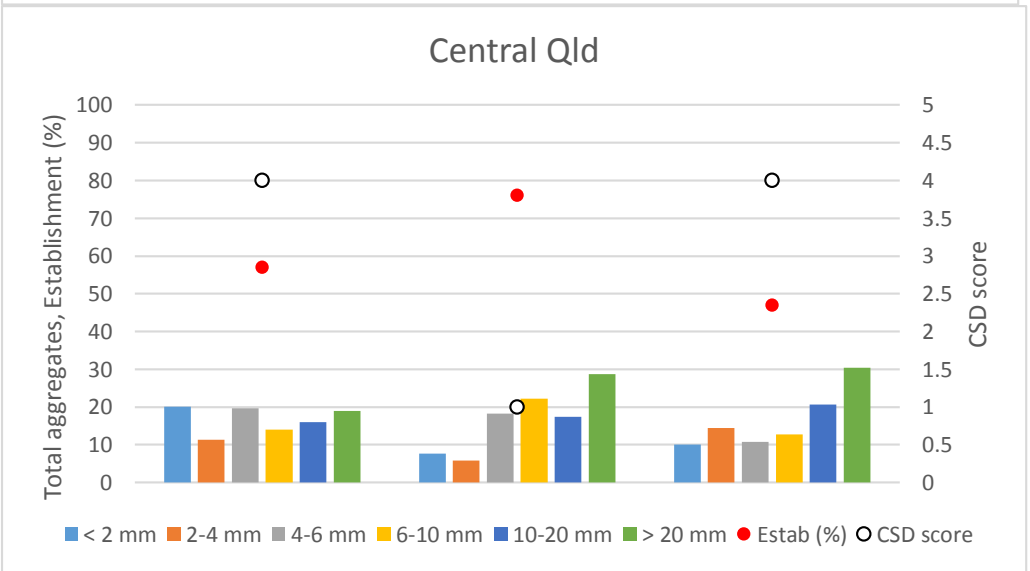
Final crop establishment and the CSD score did not always reflect final establishment as seen in the figures below from each region, which indicates that an objective assessment of seedbed condition may be more applicable than a subjective assessment: a minimum establishment level may need to be identified that more closely aligns the current subjective score to final crop establishment. Also, the CSD score is based on a visual assessment of aggregates visible on the surface of the prepared hill, whereas germination and emergence of the seedlings are affected by the aggregate size distribution around the seed: there is an order of magnitude difference in what is being assessed for seedbed condition. The scoring system is based on aggregate sizes > 2 cm for a field score 1 up to 10-15 cm for a field score of 5, whereas seedbeds consist of aggregates 2 mm to 10 mm, with an ideal distribution consisting of aggregates in the range of 2 – 6 mm as the seed size of Sicot 71BRF and Sicot 74BRF are typically 6 and 7 mm (average of longest and shortest dimensions of 200 seeds), respectively.

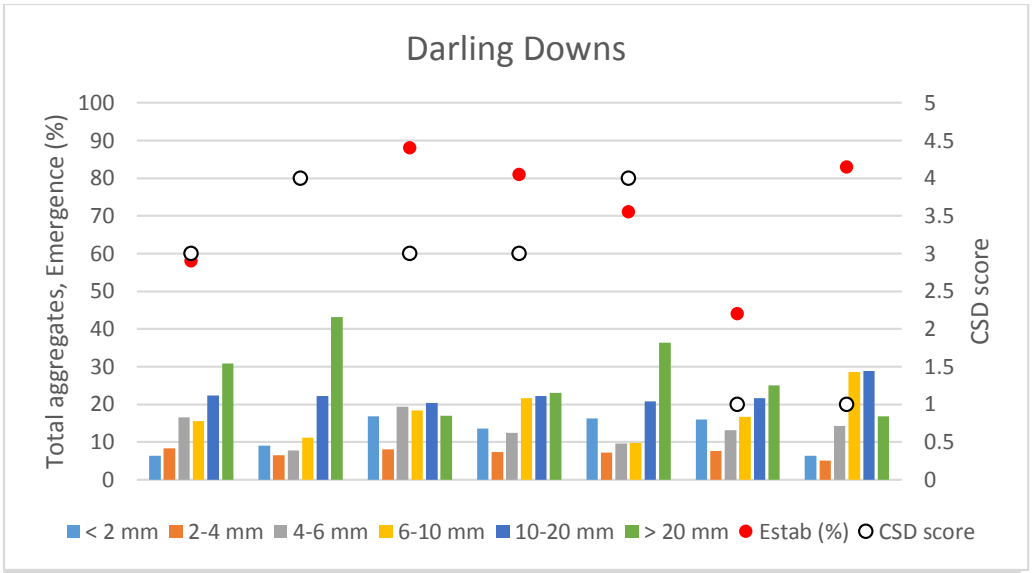


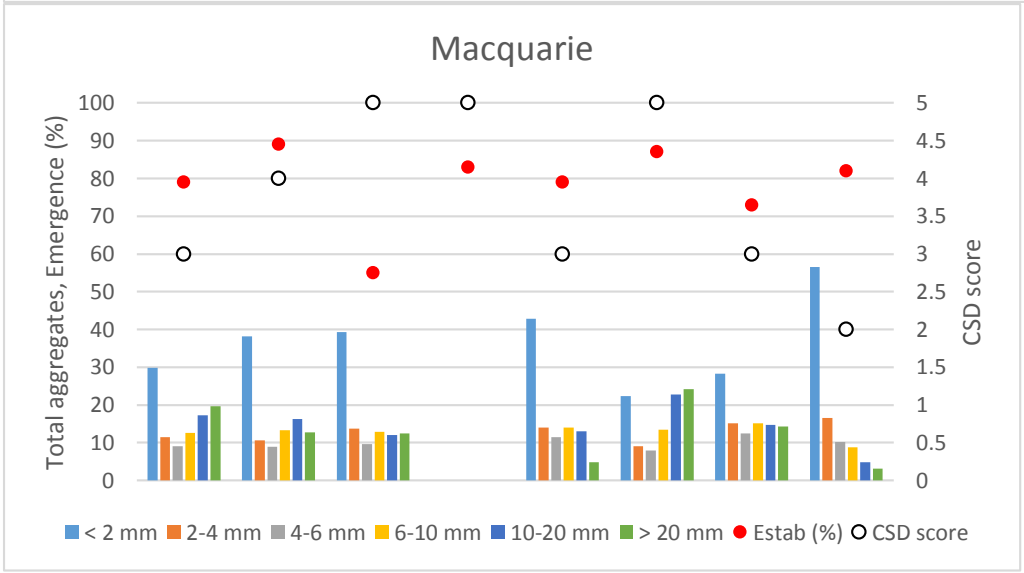



Southern NSW
Total aggregates, Establishment (%)
CSD score
100
90
80
70
60
50
40
30
20
10
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
< 2 mm
2-4 mm
4-6 mm
6-10 mm
10-20 mm
> 20 mm
Estab (%)
CSD score


Macintyre
Total aggregates, Establishment (%)
CSD score
100
90
80
70
60
50
40
30
20
10
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
< 2 mm
2-4 mm
4-6 mm
6-10 mm
10-20 mm
> 20 mm
Estab (%)
CSD score


Central Qld
Total aggregates, Establishment (%)
CSD score
100
90
80
70
60
50
40
30
20
10
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
< 2 mm
2-4 mm
4-6 mm
6-10 mm
10-20 mm
> 20 mm
Estab (%)
CSD score



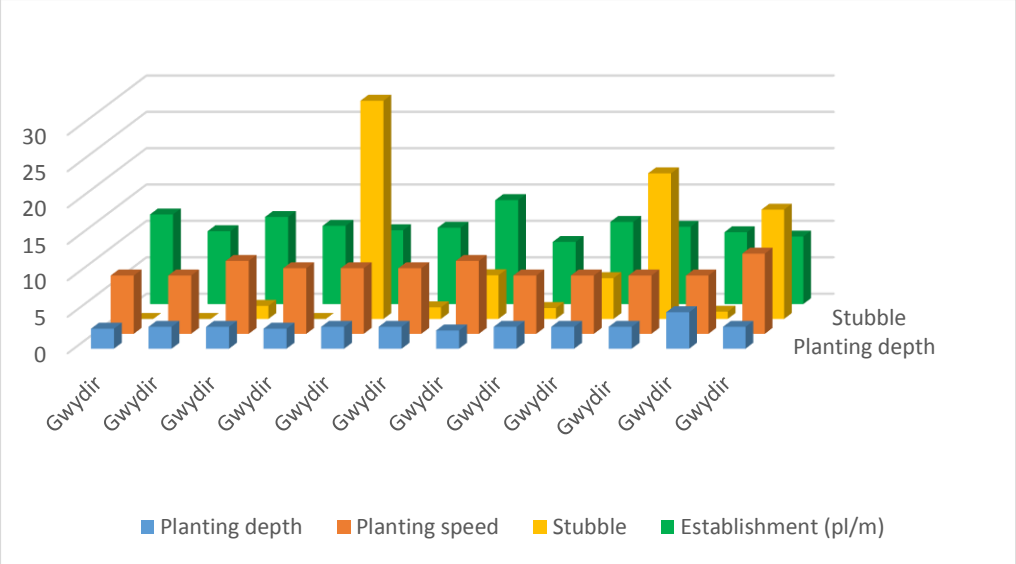


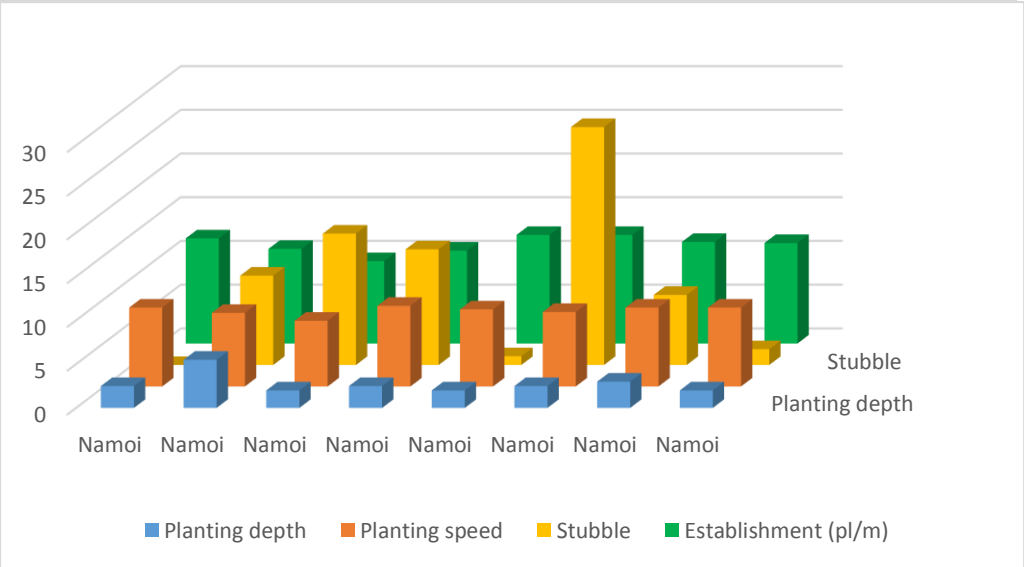
Most seedbeds tended to have a bimodal distribution of aggregate sizes, with < 2mm and > 20 mm sizes predominating. Ideally seedbeds should consist of a range of aggregates smaller and slightly larger than the seed being sown to ensure good seed soil contact for rapid germination and larger aggregates above the seed to minimise crusting which can hinder seedling emergence.

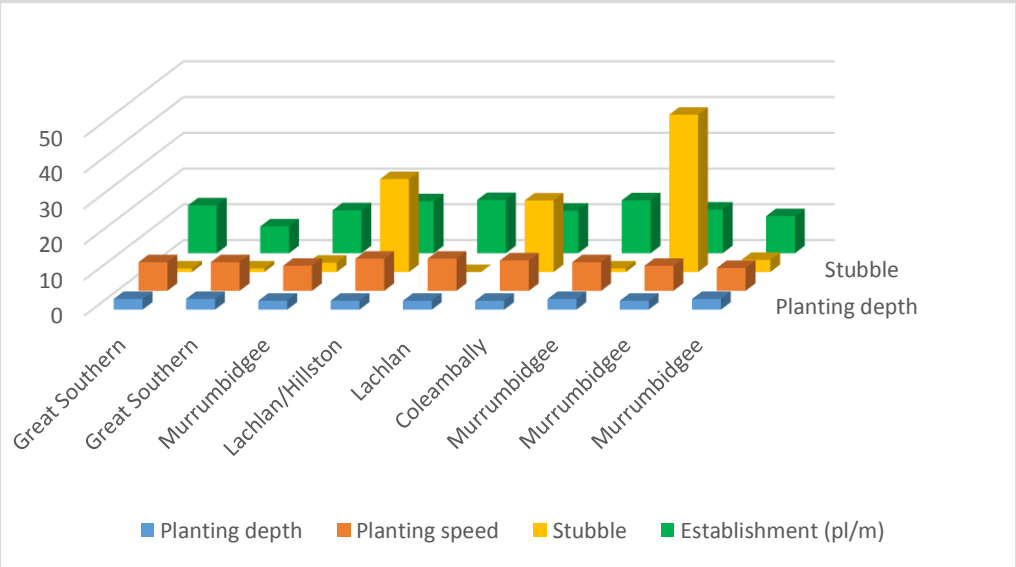
Establishment & planting speed, planting depth and stubble

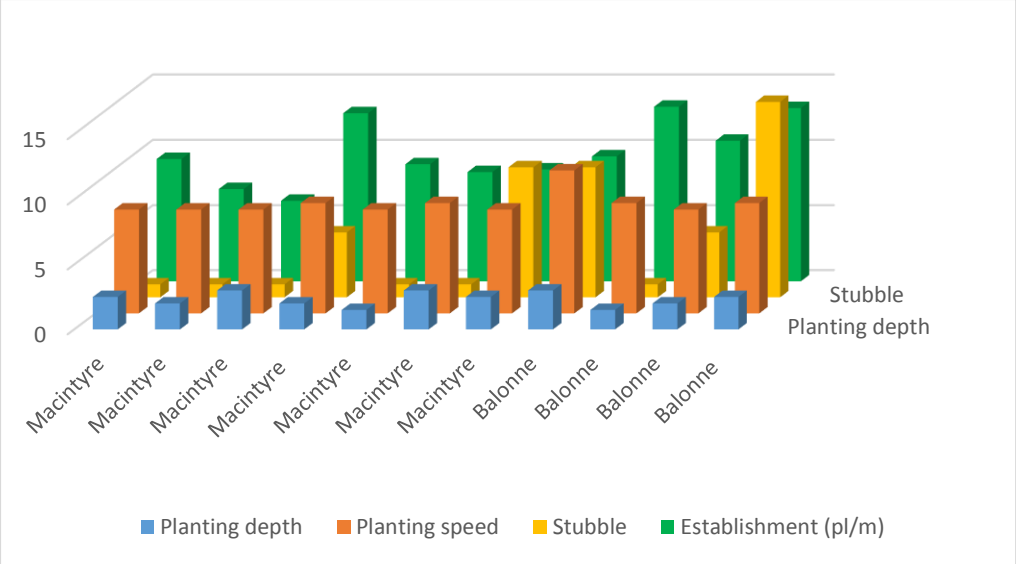
Planting speed (8-9 km/hr) and depth (2-3 cm) were consistent across all sites assessed and had little effect on final crop establishment as seen in the figures below. Stubble level had an effect on establishment with greater levels of stubble resulting in lower establishment, however this did vary across regions and sites.

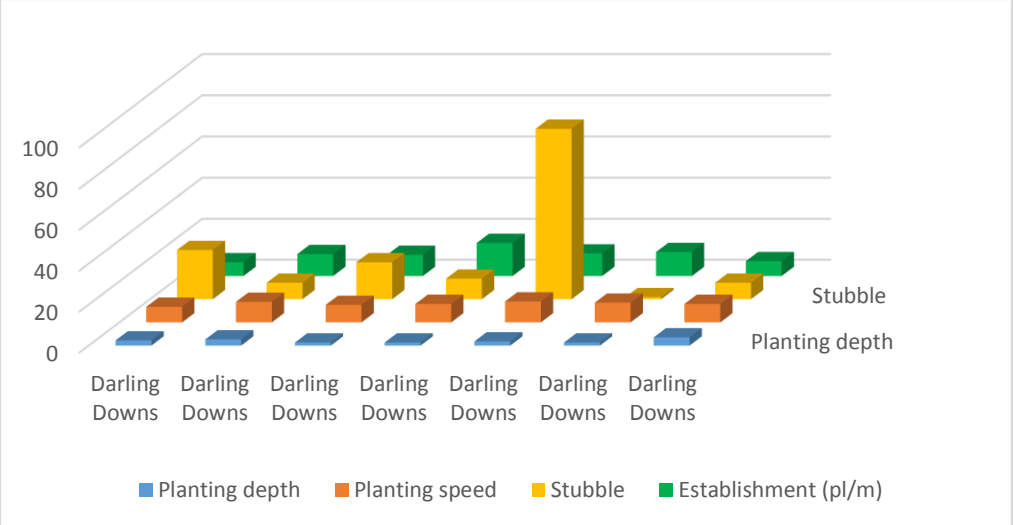
One stand-out result was the discrepancy between the planter setting of the number of seeds delivered and the resulting final establishment with a greater number of seeds being delivered compared to the final number of plants actually established (data not shown).

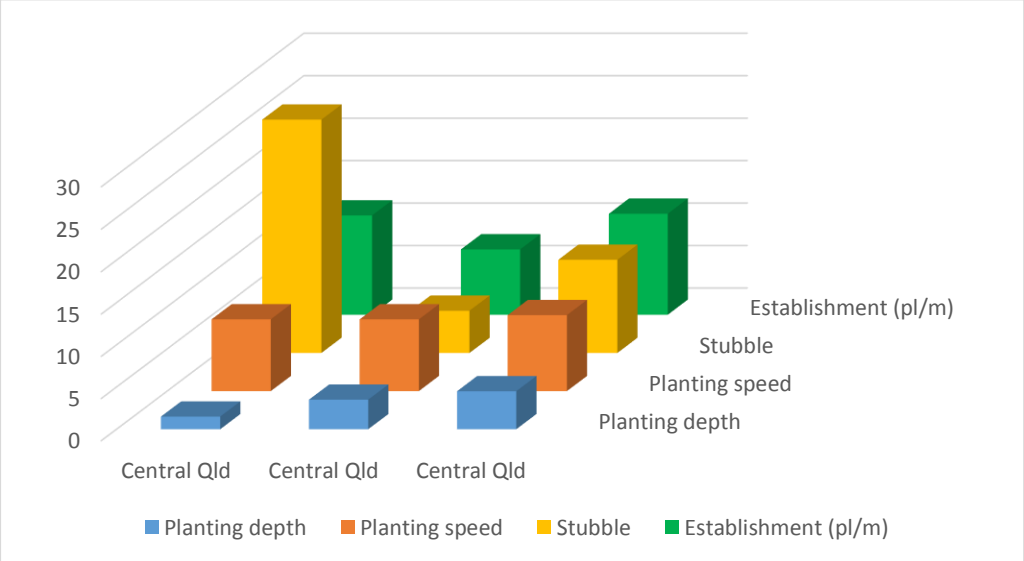

30
25
20
15
10
5
0
Gwydir
Stubble
Planting depth
Planting depth
Planting speed
Stubble
Establishment (pl/m)

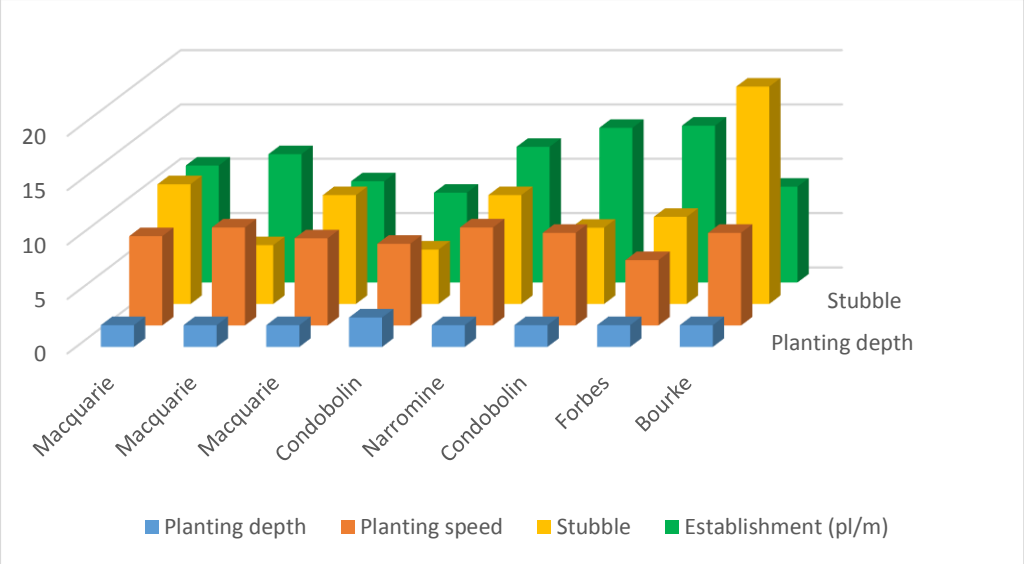

30
25
20
15
10
5
0
Namoi
Stubble
Planting depth
Planting depth
Planting speed
Stubble
Establishment (pl/m)


50
40
30
20
10
0
Great Southern
Great Southern
Murrumbidgee
Lachlan/Hillston
Lachlan
Coleambally
Murrumbidgee
Murrumbidgee
Murrumbidgee
Stubble
Planting depth
Planting depth
Planting speed
Stubble
Establishment (pl/m)


15
10
5
0
Macintyre
Macintyre
Macintyre
Macintyre
Macintyre
Macintyre
Macintyre
Balonne
Balonne
Balonne
Balonne
Stubble
Planting depth
Planting depth
Planting speed
Stubble
Establishment (pl/m)


100
80
60
40
20
0
Darling Downs
Darling Downs
Darling Downs
Darling Downs
Darling Downs
Darling Downs
Darling Downs
Stubble
Planting depth
Planting depth
Planting speed
Stubble
Establishment (pl/m)


30
25
20
15
10
5
0
Central Qld
Central Qld
Central Qld
Establishment (pl/m)
Stubble
Planting speed
Planting depth
Planting depth
Planting speed
Stubble
Establishment (pl/m)



Soil from each site is currently being assessed for the plastic limit: the point at which a soil goes from brittle fracture to deforming like plasticine, which is important for tillage and soil compaction of a soil.

Further data need to be collected during planting: soil samples should be collected and weighed at the time of planting to determine the relation to the soil plastic limit. This largely indicates whether smearing and compaction occur at planting may inhibit root growth. The soil moistures reported as 100 %, which corresponded to after watering-up and is not possible (soil is approximately 50 % solid, the remainder being air and/or water), does not provide any information as to conditions during seedbed formation.

The penetrometer readings need further thought as to how they are interpreted and used, this is something I need to consider further.

Field data need to be collected next season to determine whether the measurements are consistent between regions and environmental conditions with time: preferably another two seasons worth of data to be collected.