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Brassica juncea in north-western NSW

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Brassica juncea (Indian mustard), a close relative of canola (*Brassica napus*), is being developed as a drought and heat tolerant alternative oilseed to canola for the low rainfall zones of the Australian cropping belt. The crop has a number of advantages over canola and will deliver the same rotational benefits as canola. As a relatively new crop, breeding, selection and agronomic research have not progressed as far as canola. Continuing research will deliver significant improvements in yield, herbicide tolerance, quality parameters and crop management recommendations.

This Primefact covers the key areas of management of *Brassica juncea* for successful crops in north-western NSW. It is targeted primarily at types grown for condiment mustard, but the principles presented apply equally to juncea canola and industrial mustard. *Brassica juncea* will be referred to as *B. juncea* throughout this Primefact.

The strategies proposed are based on current information and experience with the crop in NSW. This Primefact will be updated as new agronomy and varietal information becomes available.

***B. juncea* checklist**

1. Determine if your farm is in the appropriate rainfall zone where *B. juncea* would benefit your farming system (see map page 4).
2. Ensure the market is stable and the price on offer is competitive with canola.
3. Select a paddock which:
   - is free of harmful herbicide residues
   - has good soil structure and preferably standing stubble
   - has at least 120–150 mm of plant available water in the soil profile, and
   - has a low broadleaf weed population.
4. Aim to sow in the middle weeks of May.
5. Sow seed at 2–4 kg/ha to achieve an evenly established stand of 35–50 plants/m^2.
6. *B. juncea* seed is smaller than canola, so reduce sowing rates accordingly.
7. Sow in rows 30–60 cm wide. Wider rows (> 60 cm) can reduce yield potential.
8. Apply nutrition according to soil test results – in general apply 8–12 kg P/ha, 15–20 kg S/ha and 30–50 kg N/ha.
9. Apply crop protection products to limit impacts from pests and weeds. Read Permit PER9343, (expiry 3/03/2012) before using any product on *B. juncea*.
10. Assess crop maturity for suitability to direct heading or windrowing. Note seed colour is yellow when mature.

Types of *Brassica juncea*

There are three different types of *B. juncea* or Indian mustard that growers may have access to in the next few years.

Juncea canola has oil and meal quality similar to canola and therefore has the same market end-use (Table 1). Fatty acid profiles of the oil and the level and types of glucosinolates in the meal all meet the quality specifications for canola. The oil is edible with high levels of the desirable oleic acid and low levels of erucic acid, and the meal can therefore be substituted for canola meal in animal diets.

Figures 1 and 2. B. juncea varieties are being developed for different end-uses. (Photos Don McCaffery)

Condiment mustard has different meal and oil quality to juncea canola. The level of glucosinolates in the meal after crushing is much higher than juncea canola and is responsible for the 'hot and spicy' taste of table mustard. The oil has a distinct 'nutty' flavour, but the erucic acid level is sufficiently low to make it suitable for human consumption.

Table 1. Typical seed quality characteristics for canola, juncea canola and condiment mustard when grown in north-western NSW.

Character	Canola	Juncea canola	Condiment mustard
Oil %	36–42	34–40	34–40
Oleic Acid %	57–63	57–63	variable
Linoleic Acid %	18–25	18–25	variable
Linolenic Acid %	8–13	8–13	variable
Erucic Acid %	<1	<1	1–20
Glucosinolate in meal (µmoles/g – 10% MC)	<30	<30	110–160
Allyl glucosinolate in meal (µmoles/g – 10% MC)	0	<1	NA

Industrial mustard is a *B. juncea* type that is not suited to either of the edible markets for juncea canola or condiment mustard because of the high levels of erucic acid and/or glucosinolates. Industrial mustard may have a use in a number of industrial products including biodiesel.

Advantages of growing *B. juncea* over canola in north-western NSW

B. juncea (both condiment mustard and juncea canola) is now being recognised as a good alternative to canola in the drier marginal grain growing areas of north-western NSW and has a number of important agronomic advantages over canola.

1. *B. juncea* can tolerate much drier and hotter conditions during flowering and pod fill than canola. Trials in very dry years have shown that *B. juncea* can out-perform most conventional canola varieties by at least 30%–50%. In extreme low rainfall seasons such as 2004 and 2007, mustard yielded up to 0.3 t/ha, whilst canola yielded only half this. Under dry conditions *B. juncea* is able to accumulate more dry matter than canola, primarily through greater leaf turgor pressures and by maintaining photosynthetic leaf area for longer, not by altering any of the known components of yield. Whilst the seeds are smaller and there are less seeds per pod, *B. juncea* produces more pods per plant than canola.
2. *B. juncea* has excellent seedling vigour (similar to hybrid canola), ensuring that ground cover is achieved quickly, reducing soil moisture losses and improving competition with weeds.
3. *B. juncea* is more tolerant of shattering than canola. Better tolerance to shattering has been observed in trials where *B. juncea* withstood mild hail and wind storms better than canola. Better shattering tolerance makes *B. juncea* more attractive for direct heading, reducing production costs. However, commercial growers in the north still prefer to windrow mustard crops for management convenience.

4. *B. juncea* offers similar rotation benefits to the farming system as canola. It is an excellent break crop for cereal diseases (crown rot, common root rot and yellow leaf spot). The closed brassica canopy provides the optimum environment for the rapid breakdown of cereal residue on which diseases survive. Experience suggests weed populations are less in the fallow following *B. juncea*, reducing weed control costs.
5. *B. juncea* has two herbicide tolerant (HT) varieties available (juncea canola Oasis CL and Sahara CL) but generally northern growers have not required HT and use conventional varieties.
6. *B. juncea* offers greater flexibility with a later sowing window than canola.

Disadvantages of growing *B. juncea* over canola

1. Generally hot and dry crop finishing conditions, common in north-western NSW, are not conducive to high oil contents. In areas such as Coonamble and Walgett, oil contents rarely exceed 35% (6% MC) and typically are 2–3 percentage oil points lower than the best performing canola grown under the same conditions.
2. *B. juncea* is a non-mycorrhizal crop, and so arbuscular mycorrhizal (AM) fungi (beneficial soil fungi) levels decline when growing brassica crops. This disadvantages following crops which are highly dependent on AM fungi for efficient nutrient recovery. These crops include sorghum, cotton, maize, sunflower and summer pulses, as well as faba beans and chickpeas. Fortunately, wheat, barley and oats have low dependence on AM fungi, and so can be readily grown in rotation with *B. juncea*. Where AM dependent crops are grown after *B. juncea* ensure adequate levels of phosphate and zinc are applied as fertiliser.
3. Condiment mustard is marketed under a 'closed loop' marketing system. Domestic demand is currently 2000–4000 tonnes per annum. Interested growers should ensure a delivery and price contract is in place before growing the crop. Export markets need to be developed to allow the condiment mustard industry to expand.

Suitable production zones

B. juncea can be grown anywhere in NSW where canola is currently grown. However, because of its adaptation to dry environments, the crop can be competitive with canola in cropping regions where long-term average canola yields are around 1.4 t/ha or less (see map page 4). In northern NSW this will be in areas where long-term mean annual rainfall is 425–575 mm (summer dominant) and 'in-crop' rainfall (1 May – 30 September) can be minimal. *B. juncea* will utilise retained subsoil moisture in heavy grey clay soils and yield better on these soil types with limited 'in-crop' rainfall than currently available canola varieties.

Varieties and yield performance

Currently there are two condiment mustards and three commercial varieties of juncea canola that have been tested and found to be well adapted to north-western NSW. Table 2 (page 5) summarises yield performance and oil contents over the seasons 2007 and 2008. It should be noted that data is extremely limited and therefore needs to be viewed with a degree of caution (see also Primefact 783 *Juncea canola in the low rainfall zone of south-western NSW*).

Paddock selection and crop establishment

A number of key management decisions will influence the success of your crop.

Avoid herbicide residues. *B. juncea*, like canola, is very sensitive to residues from Group B (e.g. Glean®, Logran® and Ally®) and Group C (e.g. atrazine and simazine) herbicides. Adhere to the plant-back periods following use of these herbicides and plan ahead when applying any residual herbicide. This is especially important for higher pH grey clay soils where the plant-back requirement after Group B herbicide use is 2 years.

Whilst not completely tolerant, the Imi-tolerant juncea canola Oasis CL and Sahara CL will have more tolerance of Group B herbicide residues, but will still be sensitive to Group C herbicides. Group I herbicides such as MCPA are extremely damaging if they drift onto juncea canola.

Selection 2 condiment mustard is a conventional type with no specific herbicide tolerance. All herbicides used on conventional canola can be used on condiment mustard.

Soil types. *B. juncea* will grow on most soils in north-western NSW but soils with a $pH_{Ca} < 7.0$ are preferred (heavy grey clay). However, it will also grow in sandy or red-brown earth soils. Acid soils ($pH_{Ca} < 5.0$), which are more common in central western NSW, should be checked for aluminium levels and limed if necessary. Sodic soils which crust over after rain can reduce plant establishment and are best avoided or ameliorated with gypsum prior to sowing. Like canola, *B. juncea* is quite sensitive to waterlogging.

Subsoil moisture. *B. juncea* plants respond very well to subsoil moisture, especially when sown

early into well structured, fertile soils. The plant's vigorous tap root system is able to extract moisture from deep within the profile, allowing the crop to be better buffered against the hot, dry conditions which can occur in spring. For this reason, it is important to select a paddock with good subsoil moisture. Aim to sow into a paddock with 120–150 mm of plant available water. It is also important that there is enough moisture in the seedbed as *B. juncea* needs slightly more moisture than cereals for germination and establishment. In northern NSW the best moisture will be in paddocks with stored summer rainfall and where weeds have been controlled over the entire fallow period.

Sowing into a paddock with minimal subsoil moisture is too risky, as the crop will be totally reliant on the amount of growing season rainfall to produce a profitable yield.

Retained stubble. Sowing into retained stubble will provide adequate protection for the emerging seedling, particularly against sand blasting on lighter soil types. *B. juncea*, like canola, is very susceptible to sand blasting, and is easily damaged or killed by even moderate sand blasting up until the 4–6 true leaf stage.

Stubble aids in moisture conservation during the fallow period and early crop establishment. Stubble cover minimises damage caused by soil movement (rain drop splash and sheet erosion) when the crop is very young.

Sowing time. Generally for most crops, the earlier the crop is sown the higher the potential yield. Early sown condiment mustard crops will

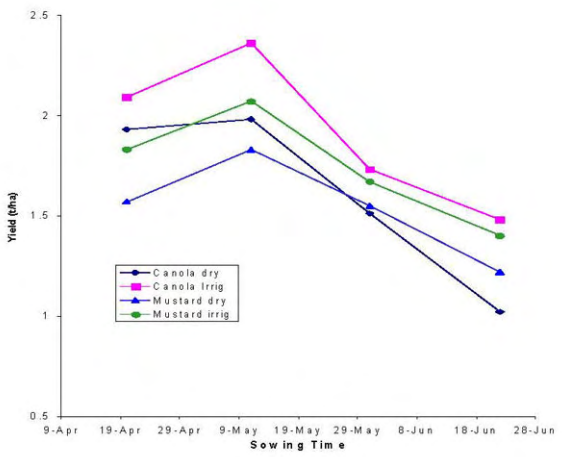
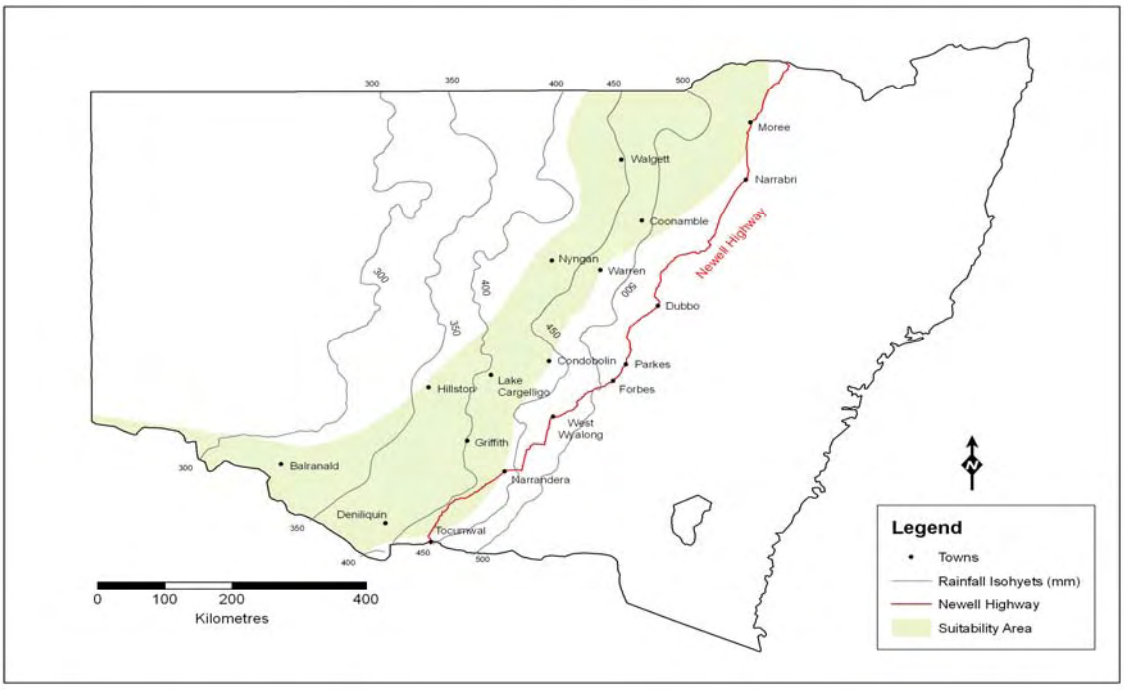


Figure 4. Yield of canola and mustard in response to sowing time and supplementary irrigation at Condobolin Agricultural Research and Advisory Station. (Source: Dr Neil Fettell)

have stronger stems and more vigorous root systems, allowing the crop to flower and fill seeds before the onset of the hotter and drier conditions of mid spring. An early sowing time is important with *B. juncea* to enable the crop to maximise its dry matter by mid flowering, providing a solid platform for seed filling when flowering ends.

However, if sown too early *B. juncea* can grow too tall, the canopy can become rank (causing harvest difficulties) and the crop is more at risk from frost damage at pod filling. In northern NSW it is better to have seed development occurring after mid September to reduce the chances of frost damage. A time of sowing trial conducted at



Variety	Type	Yield as % of Tarcoola		Oil content (%)	
		2007#	2008##	2007*	2008**
Selection 2	Conventional condiment mustard	139	180	34.1	35.4
Micky	Conventional condiment mustard	132	173	34.6	37.3
Tarcoola	Conventional canola	100	100	37.6	38.3
Ave Yield Tarcoola (t/ha)		1.48	1.00		

Note: All yield data is from northern NSW

Yield # Bellata, Tamworth; ## Coonamble, Narrabri. 2008 trials were sown very late, 26 and 28 June respectively, which heavily favoured *Brassica juncea* over canola.

Oil% s * Coonamble, Bellata, Tamworth, Merriwagga; ** Coonamble, Narrabri.

Table 2: Average yield and quality of the condiment varieties Selection 2 and Micky, and the canola variety Tarcoola in NSW in 2007 and 2008

Condobolin in 2000 highlighted the importance of early sowing time to maximise yields (Fig. 4). However in northern NSW pod filling occurs earlier and it is critical to delay sowing to mid May to reduce the risk of frost damage. Further trials are planned to determine the optimum sowing time for *B. juncea* in different environments.

The suggested sowing times in Table 3 are based on limited research and grower experience with commercial crops. Individual varieties may vary slightly. If growers choose to grow the crop in more eastern areas (medium-high rainfall), then sowing times should be delayed by one to two weeks from those nominated in Table 3.

Plant establishment. Limited data suggests that plant population targets for *B. juncea* are similar to canola. Aim for an established plant population of 35–50 plants/m^2. This may equate to 2–4 kg seed/ha, depending on seed size. *B. juncea* seed is typically only 75%–95% the size of canola, so seed size needs to be checked and seeding rates reduced from those of canola for the same plant population.

Equally important as plant population is to achieve a uniform plant density. Getting an even plant establishment is essential for a successful crop, as it provides better competition against weeds, allows more even moisture and nutrient utilisation, and promotes even crop maturity and ripening across the paddock.

B. juncea seeds are quite small and should not be sown too deep. To achieve an even plant stand aim to sow at a depth of approximately 5 cm into good moisture for self-mulching clays and 2–3 cm in red soils. Ensure sowing speeds are not too fast to minimise soil throw onto the neighbouring rows. Also ensure proper tine breakout, so that the tine operates at a constant depth across the seeder width and across soil types. Low breakout causes uneven row depth, and patchy establishment.

Table 3. Suggested sowing times for north-western NSW

	Mid April	Late April	Early May	Mid May	Late May	Early June	Mid June
Nyngan/Warren		>	●	●	<		
Walgett			>	●	●	<	
Coonamble			>	●	●	<	
Moree				>	●	●	<

● Optimum sowing time

> Early–- yield reduction likely – too vegetative, lodging, disease and/or frost

< Late – some yield reduction likely (about 10%) – lack of spring moisture and heat stress

B. juncea can be successfully moisture-seeked provided guidelines for no-till controlled traffic systems are followed. Although seed can be put onto moisture it can be difficult to prevent dry soil (removed by the delvers) from falling back into the furrow. The seedbed can become very cloddy and it is difficult to maintain good seed/soil contact, even when using trailing press wheels. It is better for growers to make an early decision, not delve as deep, remove less dry soil and maintain good seed/soil contact at the moisture interface.

Press wheel pressure is critical to ensure sufficient pressure is applied to prevent the moist soil around the seed from drying out. It is desirable to have no more than 2–3 cm of 'moist' soil covering the seed through which the seedling can emerge. Growers need to have a good understanding of their soil type, sowing speed limitations and tine breakout pressure if attempting to moisture seek when sowing.

Ensure stubble is moved to the side of the sowing row, as thick stubble will reduce establishment. Sowing points should be narrow enough to handle stubble without creating dragging, but also deliver the seed to a constant depth without excessive seed bounce. It is essential that seed is buried behind the tine, and air flow from air seeders is controlled by attaching diffusers to the tines, which stops seed from being blown from the seed row.

Innovative growers are inter-row sowing using precision guidance equipment as a suitable sowing technique for no-till farming systems.

The use of press wheels, rollers or cultipackers is advisable in most situations to ensure good seed-soil contact. Press wheels minimise excess soil being dragged on top of the small seeds, ensuring a constant seed depth and good seed-soil contact.

If the seedbed becomes wet and sticky, seed and soil may stick to the press wheel and be scraped to the surface. Under these conditions it is usually time to stop sowing and wait for the soil to dry.

Dry sowing is not recommended in north-western NSW. The practice is considered too risky for the following reasons:

- insufficient rainfall after sowing may result in a split germination, with uneven growth affecting subsequent operations
- there is no opportunity to get a pre-sowing weed kill
- some soil types are prone to crusting after heavy rainfall which can seriously affect germination
- it is possible that germination and crop establishment occurs too late for a profitable crop.

Row spacing. The optimum row spacing for *B. juncea* is similar to wheat and canola. In the low rainfall zone, row spacing is usually a compromise between what is suitable for the crop and what is manageable with minimum or no-till seeders. In most instances 30–60 cm row spacing is acceptable. Both row spacing and plant population will be the subject of further research. Preliminary trials in south-western NSW indicate that 30 cm row spacing is better than 60 cm. In these trials *B. juncea* sown in 60 cm rows yielded slightly less and had a higher frequency of lodging than the 30 cm spacing. The 60 cm spacing also resulted in less stubble after harvest, increasing the risk of soil erosion.

Crop nutrition

There is no research information to suggest that *B. juncea* has different nutritional requirements to canola. Some early research conducted in the Mallee of north-western Victoria suggested that nitrogen requirements were lower than for canola, but until further trial work indicates, fertiliser rates normally applied to canola should be used on *B. juncea*.

However, growers should note that research on black and red basaltic soils in the Tamworth district have shown that canola is more responsive to phosphorus than wheat (Table 4) and experience in the Dubbo district suggests caution is needed on grey self-mulching soils where soil phosphorus levels are low and testing indicates the presence of root lesion nematode (RLN) *Pratylenchus neglectus*.

Table 4. Canola, mustard and wheat yield (t/ha) response to phosphate fertiliser

	Black soil Loomberah			Red soil Tamworth		
Crop	0 P	20 P kg/ha	% Yield Increase	0 P	20 P kg/ha	% Yield Increase
Canola	1.32	1.95	48	0.52	1.65	217
Mustard	1.74	2.24	29	0.98	2.05	109
Wheat	3.48	4.33	24	1.35	2.58	91

Source: Holland J F et al. *Proceedings of the 13th ARAB Conference Tamworth 2003*

Depending on soil test results, target application rates are likely to be about 8–12 kg P/ha and up to 30–50 kg N/ha. Initial phosphorus trials suggest unless you are on a high phosphorus soil, apply 8 kg/ha P for every tonne of canola seed you aim to harvest. Similarly if soils are low in nitrogen, apply 40 kg/ha N for every tonne of canola seed harvested. Nitrogen should be applied at sowing as topdressing is less efficient in a dry cropping environment. Sulfur is also an important nutrient and should be applied as sulfate sulfur at 15–20 kg S/ha. However, if it is known that there are large amounts of sulfur at depth (60–100 cm) this application should be reviewed. Zinc responses are soil type specific but if a soil type is known to be zinc responsive then a zinc supplemented fertiliser at sowing is advisable.

Crop protection

Permit PER9343, (expiry 3/03/2012) permits most crop protection products registered for canola to be used on *B. juncea*. Users can obtain a copy of the permit at the APVMA website.

http://services.apvma.gov.au/permits/response.jsp

Users must carefully read the permit and comply with all conditions of the permit before applying any crop protection product to *B. juncea*.

Weed control

Weed control strategies in *B. juncea* are similar to canola. Weed control will be more difficult when growing varieties with no herbicide tolerance. The herbicide tolerant juncea canola Clearfield® varieties, Oasis CL and Sahara CL make weed control easier as the herbicide Intervix® may be used; however, the cost of post-emergent herbicides are sometimes considered too expensive in the regions that juncea canola is grown. Condiment mustard has no herbicide tolerant types available, so prior weed control must be very good.

Figure 5. Broadleaf weeds like turnip weed could be a problem in B. juncea. (Photo Jim Dellow)

For this reason, ensure the paddock chosen has low weed pressure, especially broadleaf weeds. If necessary apply one or two knockdown herbicides before sowing to assist in reducing weed numbers. Known problem weeds are turnip weed, wild turnip (on red soils) and the mustard species, and most broadleaf weeds will result in a yield penalty if not controlled.

A residual herbicide for grass weeds such as trifluralin is best ‘incorporated by sowing’ (IBS) with a knife point/press wheel seeding system. The IBS technique allows a ‘hot blanket’ of herbicide to be thrown in between the plant rows to aid in weed control and soil moisture is not lost by incorporation pre-sowing. The plant row itself may have little if any herbicide but weed control is achieved by crop competition. When using the IBS technique, it is extremely important to vary sowing speed according to the width of soil throw, so that each tine is not throwing soil into the neighbouring seed row. If soil throw does occur, significant crop damage will result.

Grass weeds can be easily controlled post emergence by Group A ‘fop’ and ‘dim’ herbicides, so long as weeds are not resistant to this chemistry.

Whilst clopyralid (e.g. Lontrel®) has been used extensively in canola for thistle and capeweed control, crop safety trials have shown a very narrow safety margin, and in a small number of instances resulted in a 5–10% yield penalty. Therefore, there could be a small trade-off when applying Lontrel® to *B. juncea*. Experience has shown that early application (2–4 leaf) to *B. juncea* reduces the risk of yield loss compared to a later (6–8 leaf) application.

Insect pests and viruses

B. juncea is subject to the same range of pests as canola and there is no evidence that the crop is more tolerant to specific pests. However, because the crop is likely to be grown in drier environments, the range of pests and populations of specific pests will be different to canola grown in medium-high rainfall environments.

The root lesion nematode *P. neglectus* has been implicated in poor canola performance in the past in some grey self-mulching soils. Therefore, before growing *B. juncea* the proposed paddock needs to be tested for the presence of RLN.

Earth mites are a common pest at establishment. In central and north-western NSW it is more likely that blue oat mite will be more abundant than redlegged earth mite. Paddocks should be assessed and if needed, treated immediately after sowing and before crop emergence with a residual insecticide.

Figure 6. Viruses diseases such as Turnip mosaic virus are more prevalent in northern NSW. (Photo Rod Bambach)

Aphids can be a particular problem as they suck sap from small plants and transmit viruses. Autumn aphid numbers can be high in central and northern areas, particularly after summer rainfall. Aphid flights are generally more common in northern NSW and infestations more likely where crops are establishing under dry, warm autumn conditions.

Aphids are the main vector in the spread of viruses. The main viruses likely to occur in *B. juncea* are *Beet western yellows virus*, *Turnip mosaic virus* and *Cauliflower mosaic virus*. The main control techniques include using seed treated with imidacloprid (e.g. Gaucho®), controlling perimeter broadleaf weeds, particularly summer growing brassica weeds, and sowing into standing cereal stubble. Standing stubble has been shown to reduce virus problems in pulse crops as the stubble deters aphid entry into the crop. Seek advice before spraying aphids in a vegetative crop.

Spring aphid infestation is common in canola when spring conditions are dry and warm. As *B. juncea* is adapted to the low rainfall, warmer environments of the cropping belt, expect some aphids in the crop as it matures. Control recommendations are the same as for canola.

Similarly crops need to be monitored for heliothis and diamondback moth (cabbage moth) caterpillars and Rutherglen bugs during spring, and numbers recorded to determine if control measures are needed.

All insecticides registered for canola are allowed under permit (PER9343, expiry 3/03/2012).

Diseases

Blackleg. *B. juncea* can be infected with the blackleg fungus, but has its own particular resistance pattern, which can be similar to canola. Because of this, the recommendations for managing blackleg in *B. juncea* are essentially the same as for canola. Ensure there is 500 m separation from last season's juncea canola or canola stubble and only grow the crop 1 year in 4 in the same paddock. Blackleg is considered a lesser problem in the low rainfall zone, so fungicide seed dressings are generally not necessary.

White rust. This disease is more prevalent in *B. juncea* than it is in canola, but is not considered a problem in NSW. The weed shepherds purse is a host of white rust.

Sclerotinia. The fungal disease Sclerotinia is not likely to be a problem in the low rainfall cropping zone. It is common in canola crops in more eastern medium-high rainfall areas and in some central and northern river valleys. It is favoured by warm, wet and humid conditions in spring. The host range of the disease includes most broadleaf weeds and broadleaf rotation crops including chickpeas, field peas, lupins and faba beans. In recent years Sclerotinia has been observed at low levels in some chickpea crops in central NSW. Crop separation and rotation guidelines are similar to managing the disease in canola.

Harvest management

The principles for harvesting *B. juncea* are similar to canola. Aim to harvest a clean, evenly ripened grain sample at a moisture content of no more than 8%.

Direct heading. *B. juncea* can be direct headed as it is less prone to shattering than canola. Direct heading is more suitable for crops that mature evenly (more common in northern areas) and are not excessively tall. Draper fronts with batt reels seem to be best suited for direct heading. Once the crop is ripe for harvesting, delays must be avoided as *B. juncea* will still shatter if adverse conditions prevail.

Windrowing. Where uneven maturity is expected or in particularly windy regions, windrowing is the safest option pre-harvest. As well as creating even maturity, windrowing enables harvest and delivery to be scheduled with other farming operations. As with canola, windrowing can occur when the seed moisture content reaches 30%–35%, and when 60%–70% of seeds have changed colour and are

Figure 7. Dark spots are common on B. juncea but do not affect yield. (photo Katrina McDougall)

firm. Windrowing before this stage results in unripened seeds which are small and pinched, and windrowing too late may promote ripe pod shattering. Seed colour changes from translucent green to yellow, as opposed to canola that turns brown then black as the seed ripens.

Desiccation. An alternative to windrowing is to desiccate the crop. Desiccation can only be done by aerial application. Apart from promoting more even crop ripening it is also used to control weeds such as thistles which could cause harvesting difficulties. Desiccation is expensive and most of the time avoidable by windrowing. Reglone® is the only product permitted (PER9343, expiry 3/03/2012) as a pre-harvest desiccant.

Marketing options

In the immediate future, all *B. juncea* types will be marketed through a 'closed loop' system. Contracted growers will be advised about delivery and payment options.

Condiment mustard currently has a domestic market of 2000–4000 tonnes. Export markets are not well developed, so any production beyond domestic requirements could become a liability for the grower. Major markets in NSW are Palos Verdes at Cowra and Yandilla at Wallendbeen.

Markets for industrial mustard are still being developed. A word of caution: *B. juncea* mustard varieties targeted specifically for industrial purposes are lower yielding than current juncea canola and condiment mustard varieties. If the oil quality of the mustard destined for industrial use does not meet quality standards of either juncea canola or condiment mustard then marketing options become extremely limited.

The Australian Oilseeds Federation (AOF) established a juncea canola working group to oversight market and quality issues. The AOF has recognised market choice protocols. See the AOF website www.australianoilseeds.com/ for more information. For *B. juncea* the market and quality issues are currently being managed through a 'closed loop' marketing arrangement. Juncea canola markets have similar 'closed loop' systems in place.

Acknowledgments

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Further information and industry contacts

Publications

Winter Crop Variety Sowing Guide 2009, NSW DPI

Weed Control in Winter Crops 2009, NSW DPI

Insect and Mite Control in Field Crops, NSW DPI

Virus diseases in canola and mustard, Agnote DPI/495, NSW DPI

Website

www.dpi.nsw.gov.au/agriculture

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