CROP SCIENCE SOCIETY OF S.A. INCORPORATED

C/- WAITE CAMPUS
P.M.B No 1, GLEN OSMOND, SOUTH AUSTRALIA 5064
INCORPORATING THE WEED SCIENCE SOCIETY

ABN: 68 746 893 290

NEWSLETTER No. 301 JULY, 2015

EDITOR - Judy Rathjen, articles welcome; Ph: 0421183978

email: juditrat@yahoo.com

TREASURER - Subscriptions
Susan Fuss
gsfuss@bigpond.com
Ph: 0407 900 055

SECRETARY - Correspondence
Neil Wittwer
nwittwer@peracto.com
0422 057 715

Next Meeting	**'AGM'**
Venue	**Richardson Theatre, Roseworthy Campus**
Date	**WEDNESDAY 29th July**

It's that time of the year again. Get behind your Crop Science Society and attend our AGM this coming Wednesday!

Speakers:

Kenton Porker: PhD Candidate - University of Adelaide

Kenton will present his exciting new findings on the main drivers of flowering time behaviour in barley varieties and how this influences yield across the South Australian cropping environment

Lachlan Lake: Senior Research Officer - SARDI

Chickpeas have become Australia's biggest pulse crop in a very short period of time. Lachlan is investigating the critical period for chickpea yield formation, in particular traits for abiotic stress and adaptation.

Triallate resistance confirmed in annual ryegrass from SA

Peter Boutsalis & Christopher Preston, The University of Adelaide.

In 2014 poor control of annual ryegrass with Avadex Xtra (triallate) in a pre-emergence herbicide field trial conducted on the Yorke Peninsula was observed. In this trial, at sowing with knifepoints and press wheels, herbicide strips had been applied with various pre-emergence herbicides including Boxer Gold (2500ml/ha), Sakura (118g/ha) and Avadex Xtra (several rates including 5 and 10L/ha). Herbicide control was poor in this trial. A contributing factor was high weed densities 800-1100 plants/m^2. Sakura was the most effective herbicide in the field trial reducing the population by at least 60%.

Plants were collected from the Avadex Xtra strips and sent for testing. The plants were grown in large pots surrounded by pollen proof cages and allowed to set seed in summer 2014-2015.

In June 2015 a replicated pot trial with different rates of Avadex Xtra, Boxer Gold (prosulfocarb + S-metolachlor), Boxer[#] (prosulfocarb) and Sakura (pyroxasulfone) was conducted. Herbicides were applied directly onto ryegrass seed that had been sprinkled onto the surface of soil. After application, the seed was covered with 5mm soil to simulate incorporation. The activity obtained using this method is about 2x the activity that might be expected from pre-emergent herbicides in the field due to the even application and incorporation, and the lack of stubble. Seed from the suspect resistant population, a known multiple-resistant population with resistance to trifluralin, and from a susceptible population were tested.

Table 1: Percent control of the Yorke Peninsula resistant population (YP-R). Included is a multi-resistant population (SLR31) and a susceptible (S). Pots were assessed 5 weeks after application.

Product rate	Population		
	YP-R	SLR31	S
Avadex Xtra			
800	6	96	100
1600	47	100	100
3200	91	100	100
Boxer Gold			
1250	68	96	100
2500	100	100	100
5000	100	100	100
1250	65	96	100
2500	65	100	100
5000	82	100	100
Sakura			
60	97	96	100
120	100	100	100
240	100	100	100

[#]Boxer is not a registered product in Australia

Strong resistance to triallate was confirmed in this population. Additionally, strong resistance to Boxer (which only contains prosulfocarb) was also observed. This indicates that the YP-R biotype possesses Group J resistance. Despite this, limited cross-resistance to Boxer Gold was observed. Even though the main component of Boxer Gold is prosulfocarb (800g/L) the addition of S-metolachlor to Boxer Gold was enough to control the YP-R biotype in this pot trial. In addition, no cross-resistance to the Group K herbicide Sakura was observed.

Triallate has been widely used in South Australia in combination with other pre-emergent herbicides such as trifluralin initially and then more recently with products like Sakura to improve annual ryegrass control. Most annual ryegrass populations in SA have a varied and mixed herbicide history, so it is often difficult to determine the exact factors that lead to resistance to individual herbicides. In this case, the fact that triallate had been extensively used over the past decade to control ryegrass suggests that intensive selection pressure has resulted in triallate resistance, rather than it occurring due to broad cross-resistance. This population is resistant to the Group J herbicides but not Group K herbicides.

For this population Boxer Gold and Sakura remain effective. However, poor control of this population could be expected from Boxer Gold under situations where Boxer Gold activity is compromised, as there is not sufficient S-metolachlor in Boxer Gold to control annual ryegrass on its own.

These findings serve as a warning that over-reliance on any herbicide including Boxer Gold and Sakura could lead to resistance.

Triallate resistant ryegrass population in the background. Front row is a herbicide susceptible population. Pots from left to right are untreated (single pot), 1600ml/ha Avadex Xtra, 3200ml/ha Avadex Xtra.

This work was supported by GRDC funding.

Sodium, calcium and magnesium ratios in soils of NW Victoria, Australia may restrict root growth and crop production

Gardner W. K. WestVic AgServices, Laharum, Victoria, Australia Email: wvicag0001@bigpond.com

Fifty six sites throughout the Wimmera region of Victoria were sampled to 1 m depth, and 1:5 extracts analysed for pH, conductivity and cation content. The relationship between conductivity measured in saturated extracts and 1:5 extracts at five sites was used to calculate cation concentrations expected if saturated extracts had been prepared.

Soils were generally alkaline and cations at depth were dominated by sodium. The ratio of sodium to calcium varied from <2.6 (10% of samples) to >85.5 (10%) to a maximum of 247.1. It exceeded 12.8 in 40% of samples, and exceeded 45.6 in 20% of samples, levels which are likely to reduce root growth and ability of roots to exclude sodium. Higher ratios were associated with depth, pH and conductivity. The issues of extrapolating from experiments in solution culture to soil, and errors likely in using 1:5 extracts are discussed.

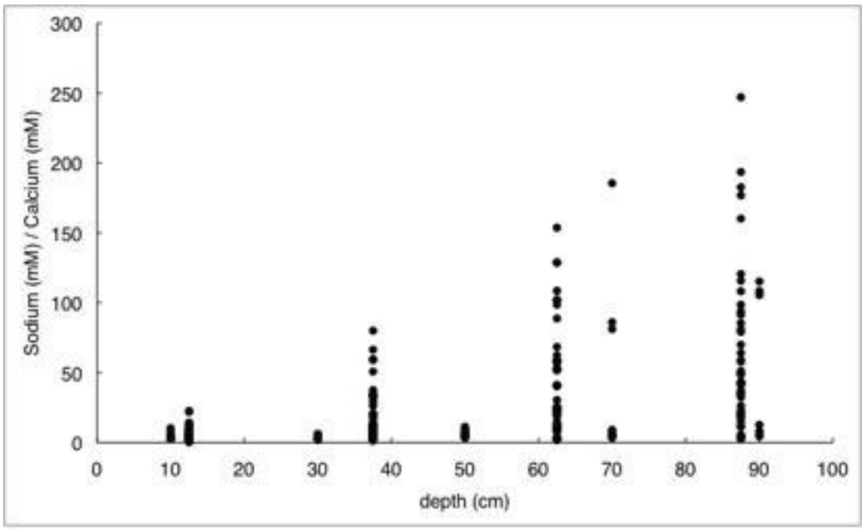


Figure 1 The ratios of sodium to calcium at various soil depths. Root growth would be reduced at ratios greater than 25.

2. High sodium/ calcium ratios in alkaline Wimmera soils: the role of magnesium and an hypothesis for their development

Sodium calcium ratios are often sufficiently high to limit root growth, and result from lower calcium rather than high sodium, and was the focus of this study.

A simple model of complex ion formation by magnesium and carbonate was derived which adequately explained the relationship between pH, calcium and magnesium, particularly the typical supersaturation of calcium with respect to calcium carbonate. Concentrations of magnesium and calcium declined when excess bicarbonate was applied, and the frequency of adverse sodium/ calcium ratios increased. Calcium and magnesium declined proportionately until low concentrations when the proportion of calcium increased.

Increased carbonate concentrations could depress calcium and magnesium concentrations to low levels with magnesium being buried in calcium carbonate and unable to redissolve once carbonate levels return to normal.

Magnesium soil amendment may be the key to addressing adverse sodium calcium ratios. Plant selection for tolerance to adverse sodium calcium ratios is warranted.

Understanding more about chickpea physiology and yield under drought and temperature stress

Lachlan Lake & Victor Sadras

South Australian Research and Development Institute

Chickpea (*Cicer arietinum* L.) is grown predominantly in south Asian and Mediterranean environments where yield is constrained by many stresses, particularly extreme temperatures and terminal water stress. Adaptation to these stresses is still relatively poor with the associated effects on crop growth and yield still not fully understood. This is particularly true in the Southern cropping region in Australia where periods of terminal drought, heat or a combination of both, can see chickpea yields fall below 0.5 t ha^{-1}. With climate extremes and variability predicted to increase in the future, it will be critical to enhance our understanding of chickpea physiology and response to temperature and water stress in order to increase yield and stability in our cropping systems.

To address this we are conducting projects to:

1. Determine the critical period for yield formation in chickpea.

Background

The effect of stress on plant growth and yield depends on the intensity, timing and duration. As such, determination of the critical period for yield formation in chickpea, the point at which yield is most vulnerable to stress, will aid in devising methods to minimize stress related yield loss. Species specific critical periods have been determined for cereals; wheat, barley, triticale and maize, sunflower and the grain legumes; soybean, peas and lupin. In cereals the critical period has been commonly identified around the stage leading up to anthesis in barley, has extended into flowering for wheat and triticale, and even further post anthesis for maize. In grain legumes, the majority of the critical period occurs further into seed set and filling with soybean identified as R1 (beginning of flowering) to R5 (beginning of seed set) and 10 days before R1 to R5 for lupin and field pea. The aim of this project was to determine the critical period for yield determination in chickpea using the most common method, sequential periods of shading to reduce crop growth rate (mimicking stress).

1. Shade treatments placed over the chickpea crops. Yellow tags are previous treatments.

Plant material, environments and experimental design

Two chickpea varieties (PBA Slasher and PBA Boundary) were grown in three environments: Roseworthy sown on 7th June, Turretfield at recommended sowing date (14th June - TOS 1) and Turretfield late sown (9th of July - TOS 2). Daily weather data was obtained from the Queensland Government, Long Paddock website (http://www.longpaddock.qld.gov.au/silo/). Thermal time was calculated from daily mean temperature using a base temperature of 0^{o}C.

A split-plot design with four replicates was used where varieties were allocated to main plots and shading treatments, including unshaded controls, to randomised subplots. Shading treatments lasted for 14 days each, and were designated sequentially from 1 to 8, starting at 31 days (353 ^{o}Cd) after sowing at Roseworthy and 24 days (251 ^{o}Cd) after sowing at Turretfield TOS 1. Turretfield TOS 2 had a shorter growing season and had 6 shading treatments in sequence beginning 35 days (399 ^{o}Cd) after sowing. Plants were hand harvested at maturity. The shades were constructed from black shade cloth that intercepted 90% of solar radiation.

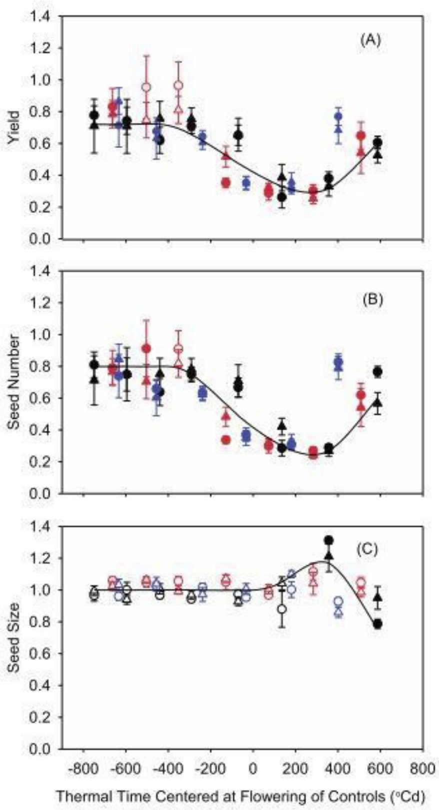


Fig. 1. Effect of timing of shading on (A) yield, (B) seed number and (C) seed size of chickpea PBA Boundary (circles) and PBA Slasher (triangles) compared to unshaded controls, at Roseworthy (black), Turretfield TOS 1 (red) and (C) Turretfield TOS 2 (blue). Open symbols are not significantly different from the control, while closed symbols are significantly different. The lines are spline curves fitted by eye. Error bars are ±S.E and are not shown when smaller than symbol. The phenological scale is based on the unshaded controls.

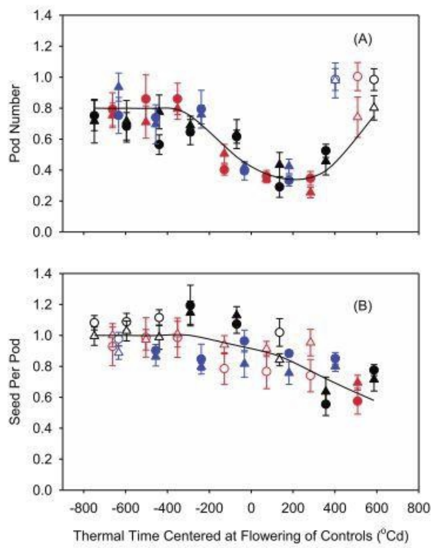


Fig. 2. Effect of timing of shading on (A) pod number and (B) seeds per pod for chickpea PBA Boundary (circles) and PBA Slasher (triangles) compared to unshaded controls, at Roseworthy (black), Turretfield TOS 1 (red) and Turretfield TOS 2 (blue). Open symbols are not significantly different from the control, while closed symbols are significantly different. The lines are spline curves fitted by eye. Error bars are ±S.E and are not shown when smaller than symbol. The phenological scale is based on the unshaded controls.

Results

There was no difference between the yield and yield components of PBA Boundary and PBA Slasher in any of the environments with the exception of seed number and seed size at Turretfield. Shading affected yield and all yield components, with the exception of Turretfield TOS 1, where seed size and pod wall ratio where unaffected. There was no interaction between shade and variety on any trait, except seed size at Roseworthy and Turretfield TOS 2. Yield had a strong positive correlation with both biomass and harvest index. Yield was closely related to seed number and unrelated to seed size. Seed number was related with both pod number and seeds per pod, but the relationship was stronger with pod number, reflecting the greater plasticity of this trait.

Critical period

The effect of time of shading on yield and yield components was consistent for both varieties and was consistent across environments on a phenological scale (Figures 1, 2). Yield decreased for most shading treatments, with reductions in response to early shading of between 20 and 30% up to approximately 300^{o}Cd before flowering. The greatest reductions started approximately 300^{o}Cd before flowering and increased to 75% approximately 200^{o}Cd after flowering (Fig. 1A). After this critical point, yield increasingly recovered toward maturity. The most critical period for yield determination, with a reduction of at least 40%, spanned the window of 800^{o}Cd centered 100^{o}Cd after flowering.

Reduction in yield was almost fully accounted for by reduction in seed number (Fig. 1A vs 1B). Seed size was largely unaffected by shading except for a ~20% increase when shade was imposed 200-300 ^{o}Cd after flowering and a ~20% decrease after this time (Fig. 1C). Seed number correlated with both pod number and seeds per pod, with no trade-off between the components of seed number.

Discussion and conclusions

The critical period for chickpea differed with other grain legumes such as lupin, field pea and soybean, where the majority of the critical period occurs after flowering. The reasons for the broader critical period in chickpea are unknown, and deserve further research. This knowledge will allow for more targeted stress mitigation practices, e.g. combining sowing date and cultivar phenology to reduce the likelihood of severe stress in the critical window. Increased knowledge of the critical period will also enhance the ability of breeders to screen for stress tolerance with more targeted stress impositions.

This is a summary of a paper published in Field Crops Research (2014) 168:1-7.

2. Search for drought adaptive traits in chickpea

Background and method

The drought adaptive traits in chickpea trial involves the monitoring of the response of 20 chickpea lines to four different environments, repeated over a three year period (2013-2015) creating 12 different environment x year combinations. Within each year, the four environments are a combination of sowing date and water regimes designed to achieve yield close to potential, terminal drought, terminal heat and a combination of both terminal drought and heat. In 2015 we are focusing on seven of the most contrasting lines from 2013 and 2014 to increase the intensity of measurements. Sowing dates were 9th June (recommended) and 7th July (late). Early-sown crops will be either irrigated, or rainfed until late July, then covered with rainout shelters to induce drought. Late sown crops will be either irrigated or rainfed.

2. Drought adaptive traits in chickpea trials with the four environments.

We will measure phenology on a weekly basis to determine time to flowering, pod emergence, end of flowering and maturity. We will use a ceptometer to measure radiation interception and RUE. We will also measure crop growth rate and biomass (using the Greenseeker - Ntech Industries, coupled with 5-7 biomass cuts). We will look at canopy temperature, stomatal conductance and N fixation. Leaf senescence will be monitored during grain fill. Mature crops will be hand-harvested to determine yield components including plant biomass, pod number, pod weight, seed per pod, seed weight, seed number, harvest index (seed weight/biomass) and pod wall ratio (pod and seed weight/seed weight). We are also monitoring temperature and rainfall variables using Tinytags, soil probes and data from the nearest available weather station.

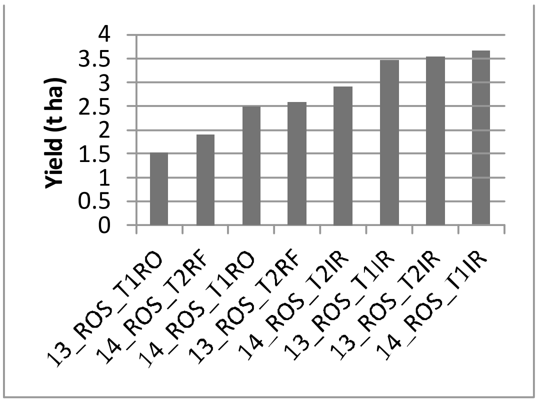


Figure 3. Yield in the eight different environments. Environments are denoted as Year_Location_Time of sowing and treatment. ROS = Roseworthy, T = time of sowing, RO = Rainout, RF = Rainfed, IR = Irrigated.

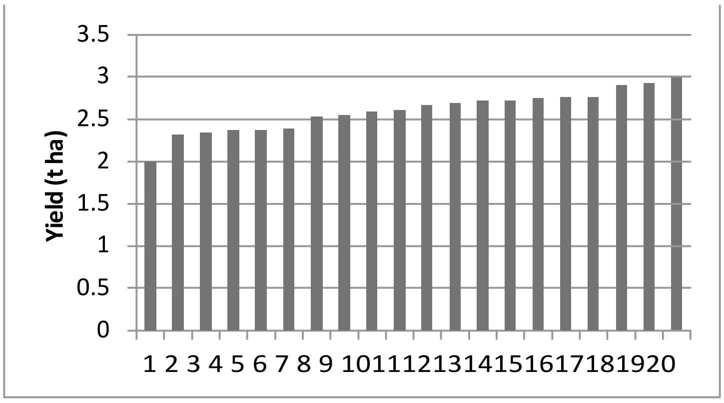


Figure 4. Yield of the 20 lines across all environments.

Table 1. Chickpea lines used to search for drought adaptive traits.

Line	Grain type	Line	Grain type
CICA1007	Desi	Sonali	Desi
CICA1016	Desi	Almaz	Kabuli
CICA1229	Desi	CICA0857	Kabuli
Genesis509	Desi	Genesis Kalkee	Kabuli
Genesis836	Desi	Genesis079	Kabuli
Howzat	Desi	Genesis090	Kabuli
PBA Boundary	Desi	CICA0912	Desi
PBA HatTrick	Desi	Jimbour	Desi
PBA Slasher	Desi	Kyabra	Desi
PBA Striker	Desi	PBA Pistol	Desi

Results and Discussion

Yields from 2013 and 2014 seasons varied across environments with more than 2 t ha^{-1} difference between the highest and lowest yielding environment (Figure 3). There was 1 t ha^{-1} yield difference between the best and worst varieties across all environments (Figure 4).

This project aims to further our understanding of stress response in chickpeas via discovery of secondary traits that are closely linked with yield in stress and non-stress environments. We will also attempt to discover the genetic basis of any traits conferring tolerance to stress. Traits and screening methods will be passed onto breeders for incorporation into new elite varieties.

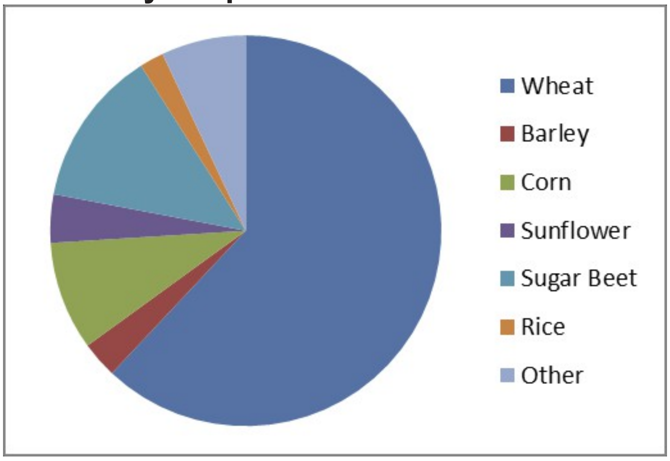
Acknowledgements

GRDC funds our research in pulses. We also thank the Australia-India Strategic Research Fund for financial support. We thank Michael Lines, Stuart Sheriff, Kathy Fischer and John Nairn for the establishment and maintenance of crops, Dr Kristy Hobson for sharing knowledge and her assistance with germplasm.

Turkey and wheat growing. Peter Smith

Wheat is one of the most important agricultural commodities in Turkey, and the country ranks among the top ten producers in the world. It is a staple and strategic crop, and an essential food in the Turkish diet, consumed mostly as bread, but also as bulgur, (made from the groats of several different wheat species, most often *durum*) yufka (flat bread) and cookies.

Income by Crops



Wheat in late spring. Small paddocks near the towns.

Total annual wheat production is approximately estimated at 17.7 million tonnes per annum. Value adding via processing make the wheat industry one of the major sectors in the economy. Wheat production increased in the late 1970s, enabling the country to become a wheat exporter, though production declined in the 1990s.

WHEAT	1980	1985	1990	1995	2000
Production (tons)	16 554 000	17 032 000	20 022 000	18 015 000	18 000 000
Harvested area (ha)	8 956 000	9 274 500	9 432 309	9 400 000	8 650 000
Yield (kg/ha)	1 848	1 836	2 122	1 916	2 080
Import (tons)	-	781 923	2 180 731	1 253 331	963 000
Export (tons)	338 049	268 923	24 975	232 847	1 782 048
Consumption (kg/per/yr)	201.0	207.6	201.8	197.0	187.4

We toured Turkey in April this year seeing the small John Deere headers appearing on the roads as contractors prepared for harvest. Most of our travels were in the Aegean and the 3 central regions (see map) where we observed mixed livestock and cropping farms with small scale mechanisation and still examples of the use of animal power. The holdings are small and we discovered that the mean farm size was 27.4 hectares, with a range from 0.5 to 620ha on grazing properties in the east and mountainous areas. Wheat is the most common broadacre crop; some is irrigated (on average 23%) and farmers owned 55% of farmland, 20% was sharecropped and 25% was rented.

In the regions we visited, infrastructure such as water and energy was similar to Australia, however as you travel east infrastructure declines to quite basic in many areas and this affects human health and the time spent in non-productive farming activities. Poverty and lower standards of living are very obvious particularly in the rural communities, and it was common to be told that the government in recent years has invested heavily in Agriculture. Like Australia the average age of farmers is high, mass immigration of young people to cities is common and attracting new people to the industry and lifting the levels of training of farmers is difficult.

The people of Turkey are wonderful and eating foods from their markets and roadside stalls was a treat. Their flat breads and particularly their risen breads were wonderful - a historical German baking influence I think.

I highly recommend Turkey for your travels.

The following is a synopsis of a publication titled

“**Adoption and Impacts of Improved Winter and Spring Wheat Varieties in Turkey**”

Authors: Ahmed Mazid, Koffi N. Amegbeto, Mesut Keser, Alexey Morgounov, Kenan Peker, Ahmet Bagci, Mustafa Akin, Murat Kucukcongar, Mustafa Kan, Sevinc Karabak, Arif Semerci, Ahmet Altikat and Sadiye Yaktubay 2009

I have selected relevant aspects of the article to provide some background to the Turkish farming culture and wheat growing in Turkey.

Rural poverty in Turkey

Although rural poverty has declined in Turkey over the past decade, extreme disparities of income and poverty levels persist across the country. In 2007, it was estimated that 0.63% of the Turkish population lived below the poverty line (US$2.15 per day). In poor rural areas, family sizes are nearly twice the national average, adult literacy rates are far lower than the national average, there are fewer doctors, agricultural production per capita is lower, and fewer women are employed.

More rural people live in poverty than urban people. The overall poverty rate in rural households is 35%, however, the margin between rural and urban households is diminishing as more rural people migrate to urban areas, mainly in the more prosperous western parts of the country. The poorest rural people are self-employed and unpaid family workers. They include small-scale farmers and their households, and people who live in remote and isolated areas. Women and unemployed young people are particularly disadvantaged.

Hill town with narrow crop strips.

Sheep and cropping is very common

The common causes of poverty among disadvantaged people in Turkey's rural areas include:

· large family size and the small landholding size,
· long-term environmental problems such as overgrazing and soil erosion, · a lack of infrastructure such as roads and markets in remote areas, and · the lack of an effective welfare safety net.

Government policies towards increasing wheat production

In Turkey, the government stimulates agricultural production through crop subsidies, low taxation, price supports, credit with subsidized interest rates, research and education programs, and the establishment of model farms. It also controls the conditions under which farm products can be traded and for some products such as grain, the government is the sole exporter. For nearly all crops, the government provides support for the use of certified seeds. The largest support is in the form of a direct rural income support of US$88.33/ha. Drought Support was added in 2007, for example, when US$125/ha was paid to producers in 40 provinces as part of relief from a severe drought.

Wheat producers are subsidised; in 2007 they received the following towards the cost of:

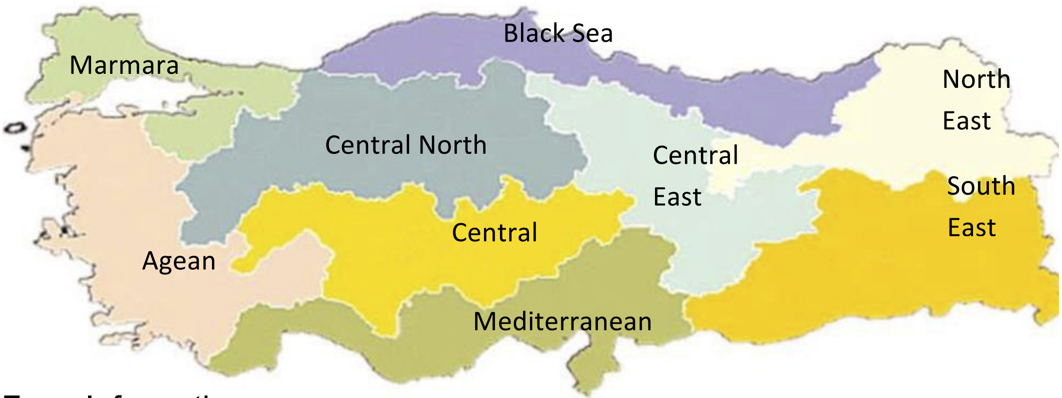
Fuel	US$24/ha
Fertiliser	US$17.8/ha
Soil analysis	US$8.3/ha
Direct Income Support	US$88.3/ha
Certified Wheat Seed	US$41.7/ha
Promotion of Organic Production	US$25/ha

It is estimated that together, all subsidies to wheat production amount to US$200/ha, excluding price support, or US$37.5/t

Historic wooden threshing boards which were horse drawn over the reapt grain (often with sleeping farmer on board for ballast). Close up shows replaceable grinding stones.

Marketing
Between 1938 and 2002, the wheat market had been state controlled through the Turkish Grain Board (TGB), which announces official prices and aims to purchase all wheat grain from producers. However, since 2002, the market has been slightly liberalized, and the TGB now only declares the buying prices. The purchasing price of wheat has since been determined by market forces, depending on the quality and quantity of the grain. In relation to producer price support, there is a direct subsidy, being US$0.0375/kg of wheat, paid to producers.

Agricultural zones of Turkey



Farm Information

Mean totals (ha)	Central East	Central North	Marmara	South East	Central
Landholding	16.6	31.7	20.0	38.9	29.6
Arable land	16.3	31.5	20.0	38.6	29.4
Irrigated area	6.7	3.1	2.0	8.6	11.7
Owned land	8.3	12.4	12.5	20.6	22.6
Share cropping land	3.3	10.3	2.6	8.0	3.1
Rented land	5.0	9.0	4.9	10.3	3.9

Climate

Region	Topography and Agriculture	Climate
Marmara	low hills and rolling farmland excellent for fruit (apricots, grapes, peaches) as well as vegetables, sunflowers and grain. higher mountains 2500m+ in the south	Rainfall : 668 mm per year; Temperature range: -8C to 43C. Humidity averages 73%
Agean	a true **breadbasket**, with low hills and higher mountains framing fertile valleys full of rich **alluvial soil**. Crops- tobacco, sunflowers, olives, figs, peaches, pears and apples.	Rainfall : 645 mm per year; Temperature range: -16C to 40C. Humidity averages 69%
Mediterranean	**Hemmed in by high mountain ranges** fringed with white sand beaches. Some agriculture on northern plains.	Rainfall : 777 mm per year; Temperature range: -5C to 45C. Humidity averages 69%
Central Regions	**High plateau** (elevation 900mof rolling steppe framed by mountain ranges, some of which are snow-capped dormant volcanoes. The land produces summer and winter wheat and other crops, and feeds millions of grazing sheep.	Rainfall : 382 mm per year; Temperature range: -25C to 40C. Humidity averages 62%
Black Sea Coast	**lush and green** with weather from the winds crossing the Black Sea rise to vault the coastal mountains. Suits tobacco, tea, **Cherries** and **hazelnuts** of which Turkey supplies half the world's requirements. Dairy cattle produce Turkey's **best milk, cream and butter**.	Rainfall : 781 mm per year; Temperature range: -8C to 40C. Humidity averages 72%
North East	**Mountainous, rugged and** relatively poor country, with wheat, fruit and nut orchards, and lots of grazing sheep.	Rainfall : 560 mm per year; Temperature range: -43C to 38C. Humidity averages 72%
South East	Down near Syria on the banks of the rivers **Tigris a**nd **Euphrates i**t's **hot** most of the time. Irrigated crops from the gigantic **Southeast Anatolia Project** (GAP) irrigation and hydroelectric power system.	Rainfall : 576 mm per year; Temperature range: -12C to 46C. Humidity averages 56%

Physical Capital

% of farmers that have	Central East	Central North	Marmara	South East	Central
Tractor	82	73	82	65	78
Header	2	2	2	1	7
Car	35	30	32	14	38
Cattle	51	39	61	52	26
Sheep &/or goats	4	14	6	2	24
Telephone	77	78	78	89	79
Satellite dish	69	82	86	61	64

Human Capital

	Central East	Central North	Marmara	South East	Central
Family size	6.1	6.8	4.6	9.3	6.6
Size of family labour	1.8	1.5	2.2	2.8	3.1
Age of farmer (years)	51.7	53.6	52.7	47.2	49.7
Ag. experience (years)	32.1	30.2	33.3	27.3	31.0
Farmers who studied Agric. %	10	4	1	3	2
Education (%)					
none	1.5	1.5	1.1	11.5	3.0
Can read and write (only)	3.8	2.3	1.1	0.8	2.0
Primary only	76.9	84.6	86.7	74.6	85.0
Secondary	16.2	11.5	11.1	9.2	10.0
University	1.5	-	-	3.8	-

Financial Capital

	Central East	Central North	Marmara	South East	Central
Mean household income ($A)	24,132	23,928	29,762	33,329	25,847
% of income from wheat	49.1	49.4	28.9	69.8	33.2
% off farm income	1.7	6.7	3.1	0.5	5.2
GM ($A/ha)					
New varieties	665	315	724	463	414
Ave of all varieties	509	135	610	510	281

Gross margins are estimates after accounting for government support.

Wheat Varieties

5 new varieties released in 2007 have become common in all districts, however many growers still use older less efficient varieties often due to cost of new seed.

Varieties	Potential Yield (kg/ha)			Test Weight (ave)	1000 seed weight	Protein
	Good year	Normal Year	Dry Year			%
Ceyhan	7360	6320	5230	78.0	35.2	12.0
Demir	6000	4000	2500	77.7	33.2	12.4
Karahan	5000	3500	2000	78.8	33.7	12.7
Pehlivan	6740	6740	2000	78.5	37.1	12.1
Saricanak	8380	5000	2800	80	35.4	13.3

Inputs	Kg/ha
Seeding Rate	240
Nitrogen	123
Phosphorus	61

NB. Chemicals are used but were listed only as total volume of pesticide applied.

Yields

Yields (kg/ha)	New Varieties	Old Improved Varieties	Mean
Rainfed	3920	1654	2692
Irrigated	4290	3736	4054

Conclusion

From touring observations and minor research it is obvious that wheat cropping is paramount to the agriculture of many regions in Turkey. Yields are "good" on these productive and in many cases volcanic soils. Rural poverty is hampering the development of improved capacity and like all countries the top 25% of farmers are more wealthy and innovative. Little conservation farming was obvious, it appears as though multiple tillage including mouldboard plough and rotary hoe is still predominant.