

Sunflower No-Till Planting: Difficulties and Solutions

Alfredo Lange

CREA Mar y Sierras Consultant

11 de Septiembre 2860, Mar del Plata 7600, Argentina, alfredolange@fibertel.com.ar

ABSTRACT

- Several difficulties arise for No-Till sunflower crops. Stubble on the soil surface causes mechanical problems to planters, modifies soil temperature and heat flow, retains herbicides and nutrients, and provides a more favourable habitat for several pests which increase potential damage. Soil compaction caused by wheel and animal traffic affects root development and crop yield. Crop nutrition requires specific-site programs adapted to undisturbed soil and stubble cover. Weed control is limited to available herbicides efficacy and efficient applications. Further, sunflower stubble and herbicides carryover may add difficulties or restrictions for the following crops. Most of these difficulties have more or less effective solutions that may result at costs allowing sunflower to compete with alternative crops.
- Research work has contributed largely to solve problems and improve management practices. A major contribution has been on weeds control by integral programs and the introduction of clearfield technology. Contributions to better understanding of soil compaction, prevention, and corrective tillage have been essential.
- Continuous research and extension work will be necessary for future sustainable and competitive sunflower cropping, particularly for No-Till planting; much more research resources are applied to alternative crops that can take area from sunflower. The prevention of emerging adversities as weeds resistance to herbicides, better solutions to remaining difficulties as control of slugs and pillbugs, and improved diagnosis of deficiencies for more efficient crop nutrition should be included within the main topics for future research. Adoption of standardized seed vigour tests is still pending.

Key words: No-Till planting - Sunflower

INTRODUCTION

The adoption of No-Till systems for sunflower production requires changes, particularly in planters and management practices (ASAGIR, 2001). Several difficulties arise for efficient planting, acceptable stand establishment, weed control, pest management and crop nutrition; here will be discussed those particular for No-Till sunflower cropping, and others that can occur in tillage systems but are more problematical in No-Till.

For the Southeast of the pampas region the area reported as No-Till cropped sunflower in 2001/2002 was 30%, while other cash crops (wheat, corn and soybean) ranged around 60 to 70%; this wide difference was the farmers response to more frequent and severe factors affecting sunflower. Practical solutions improved this figures; seven years later sunflower approached 80% No-Till planting adoption, a similar level of 2008/2009 overall adoption for cash crops reported by the Asociación Argentina de Productores en Siembra Directa (AAPRESID, 2010).

The sunflower cropping area is extended, with widely differing soils and climate, so large variations occur in limiting factors for crop success and yields. Difficulties discussed here may show up in some regions, or be restricted to a variable number of plots within a region, and the intensity of negative effects may also be different within a plot.

Solutions may be more or less effective, but always at a cost that allows the crop to compete in economic results and risk with the alternative crops. Research work, many “on farm” trials, commercial companies’ experimentation and professional advisors contributed to successful results that raised the adoption of No-Till sunflower (ASAGIR, 2007, Quiroga y Pérez Fernández, 2008) to stand in competition with other crops. Is an imperative goal the development of more effective solutions for the remaining difficulties and the anticipation of new ones that will appear.

STUBBLE ON THE SOIL SURFACE

Mulch from previous crops and weeds residues is the most valuable cover to protect and preserve soils but, besides, causes several difficulties: a) mechanical difficulties to planters, b) modification of soil temperature and heat flow, c) retention of herbicides, pesticides and fertilizers, and d) favourable habitat for pests.

a) Mechanical difficulties to planters: No-Till planters are expected to perform under different types and volume of covers, and to be adaptable to a variety of crops; row planters for sunflower have standard spacings of 70 cm and 52 cm with different arrangements and attachments as row stubble cleaners, deep banded fertilizing, seed covering devices, etc. Anyhow, abundant stubble with uneven distribution and/or humid condition, bumpy soil surface and irregular soil compaction at furrow seedbed level, too humid soil making difficult a proper degree of contact and coverage of the seed, are some of the problems to be minimized with an adequate planter.

b) Soil temperature and heat flow: mulch lying on the soil surface influences soil’s heat supply, acting as insulating material. In spring, at early-planting sunflower time, soil temperature under stubble is lower than at bare soil, and seed germination is retarded. Low soil temperature is more critical for high oleic cultivars. Row cleaners in planters leave bare soil over seed row and usually improve emergence.

Compared with bare soil, late frosts cause more severe damage to sunflower plants at early vegetative stages when soil is covered by abundant stubble. Moreover, lower soil temperatures reduce nitrification rate and available nitrates for the crop.

c) Retention of herbicides, pesticides, and fertilizers: stubble on surface reduces effectiveness of treatments with soil residual herbicides applied prior to or after planting for preemergence control of annual weeds; insects and other pests protected by cover are not reached with pulverizations; ammonia volatilization from urea and urea containing fertilizers broadcasted over residue covered soil reduces the efficiency of N utilization.

d) Favourable habitat for pests: slugs (*Deroceras spp.*) and pillbugs (*Armadillidium vulgare*) turned to be frequent No-Till pests in humid regions; abundant crop residues contribute to cutworm problems and interfere with rescue treatments.

SOIL COMPACTION

Soil compaction has been widely studied; occurs in all tillage and no-tillage systems, and affects all crops. Very different severity condition can develop in different soils with diverse background, crops and technologies applied; each particular situation has to be evaluated to decide corrective tillage and strategies to minimize compaction.

A general advice propose that before introducing No-till, any deep severe compaction caused by machinery traffic and tillage (so called “plow floor” or “disk floor”) should be alleviated by subsoiling with deep rippers down to 30-40 cm; on practical grounds this tillage has been of very limited adoption.

In compacted soils roots are restricted to a shallow and smaller volume of soil; shallow rooting of sunflower may result in nutrients deficiencies, lower yield, and more exposure to fall down than other crops.

While tillage systems loose every year any compaction in the upper layer down to plow or disk depth (or deeper, by subsoiling), soils under No-Till systems add compaction crop after crop; Ferraris (2004) has evaluated this increasing compaction and positive yield responses to appropriate subsoiling management; further research showed improvement of soil physical properties and yields of corn (Álvarez *et al.*, 2009) and sunflower (Botta *et al.*, 2006) while the persistence of the effects of mechanical decompaction were of short duration, about 2 years, and traffic on loose soil restored compaction in the 30-60 cm depth range. Adoption of “controlled traffic” within a field through traffic paths is low. Research by Botta *et al.* (2010) quantified how traffic with heavy high axle load equipment increased soil compaction and decreased yields of soybean.

After few years under No-Tillage the top layer turn firm, and compaction forces effect tend to localize more superficial; such a compacted layer not exceeding 7-10 cm may be minimized with fluted coulters and/or deep-fertilizing openings. Cattle’s grazing on crop stubbles causes similar soil surface compaction, which can be restored with the same tools.

Compaction and erosion susceptibility may be different within areas of the same field as a result of soil variations from place to place, requiring specific-site evaluation and different treatments.

SEED QUALITY

Good seed quality is always necessary, but for No-Till early planting sunflower is essential. Seed germination is retarded by lower soil temperature under stubble. High seed vigour is an indispensable condition to obtain an acceptable number and uniform stand of plants.

Standard germination tests have been considered not reliable enough to show the vigour status of sunflower seed; developments of more specific vigour tests were recommended (ASAGIR, 2001). Different vigour tests have been tested and compared with standard germination procedures and field emergence (Murcia *et al.*, 2001, Murcia *et al.*, 2002) at the seeds laboratory of Balcarce Experiment Station; this research concluded that in almost all cases cold test with compost and electric conductivity predicted seedling emergence in early sowings. A technicians meeting on sunflower seed quality (Pereyra, 2002) summarized comprehensive information and requirements. Remains as a critical difficulty the lack of standardized vigour tests.

For checking quality, seeds should be available a minimum of 40 days before planting date, because when a vigour tests is not good enough and seed is replaced, time for a new laboratory test is necessary. A practical difficulty is that sometimes seed is delivered or purchased too late.

Several seed companies offer “premium seed” of top quality for No-Till; somewhat more expensive, of course, but many farmers accept a higher price for higher quality guaranty.

NUTRITION

Sunflower fertilization in Argentina under conventional tillage has been limited to areas of low available P. Low rates of 50 to 80 kg/ha of 18-46-0 applied in the row at planting was the usual fertilization program. Changing systems from plowing and cultivation for cash crops alternating with perennial pastures to permanent No-Till agriculture, magnified the negative balance sheet of nutrients.

Nitrogen as nitrates is usually the most depleted nutrient. Surface residues cover increases water infiltration, and reduces evaporation; leaching or denitrification may increase nitrogen losses; lower soil temperatures slow down nitrification, while increased microbial activity under the mulch layer utilize available nitrogen. As a result of losses and immobilization, deficiency of available N for sunflower development occurs. Development of a fertilization program for each particular situation becomes difficult. There was a lack of accurate and reliable methods of soil sampling, analysis, other tests of nutritional status, and experimental trials of sunflower responses to fertilization in No-Till.

New research on diagnostic methods took place (Gonzalez Montaner and Di Nápoli, 2000); up to date many trials through de humid and semiarid pampas improved the referential support for fertilizer recommendations; adjustments in soil sampling, nutrients and fertilizer management have been summarized in several extension publications (Díaz Zorita, 2005; Díaz Zorita y Quiroga, 2007). Results of 80 trials of P and N fertilization across the sunflower growing area (Díaz-Zorita and Fernández

Canigia, 2010) have shown responses averaging 10% to 25 % at different regions, with large variations within regions.

The trend towards more frequent responses seems to be consistent. Solutions are showing up, but it's still difficult to recommend and execute accurate fertilization practices for each plot, such as specific-site fertilization. Boron is another known deficiency (Balboa et al., 2011) that should be studied more intensively; sulphur and potassium too. As compared with wheat, corn and soybean, research on No-Till sunflower fertilization has been -and remains- limited.

Long time stratification of nutrients in the top layer, and fertilizers broadcasted or narrow banded in the seed row fertilization to the crop may restrict nutrients availability during drought periods when the top layer becomes dry. Soil sampling and fertilizing programs must be adapted to No-Till.

ANIMAL PLAGUES

Kingdom Animalia has had always a large number of representatives feeding on sunflower crops, from little mites to big birds as Ñandú, and mammals like wild rabbit. A description of pest complex, biology, thresholds and control tactics has been summarized by Manetti et al. (2007).

No-Till provide a better habitat for several plagues: rootworms, ants, grasshoppers, armadillos, slugs and pillbugs.

Slugs (*Deroceras reticulatum*, *D. leave*, *Mollusc*) and pillbugs (*Armadillidium vulgare*, *Crustacea*) came out as severe pests in the southeast humid region with No-Tillage; they are often together in the same plot, with uneven distribution and places with very high populations. Sometimes damage is so severe that the crop must be planted again. Appropriate row-cleaning attachments may lessen attack intensity; grazing or removing part of the stubble can reduce populations and damage. Sampling and monitoring techniques have been developed for mapping their distribution in the field. Several professional groups provide monitoring, advice and application of baits.

However, good and even control is difficult to achieve, leaving patches with poor stand of plants. Some unsuccessful control programs with baits are caused by rains, delayed applications, amount of baits not sufficient and other factors out of control.

Available commercial baits contain metaldehyde for slugs, carbaryl for pillbugs, and metaldehyde plus carbaryl in dual purpose baits. The high cost of sampling, monitoring, baits and broadcasted application of baits discourage sunflower planting in infested plots; cost may be over 35 US\$/ha, without guarantee of satisfactory control.

Recent research (Faberri et al., 2011) demonstrate how soybean litter provide best conditions for increased populations of pillbugs, and fields with soybean as preceding crop or frequent soybean before in the crop rotation undergo more damage threat. Sunflower crops following wheat or barley plus soybean as second crop are at risk, slugs and pillbugs will grow fast and protected under abundant nutritive stubble.

Seed treatments with insecticides are a regular practice; actually, most commercial seeds are treated with clotianidin or tiametoxan, which provide partial protection against soil insects at germination and emergence. No soil applied insecticides are used, being limited by high cost.

Control of ants and grasshoppers is effective with registered insecticides; increased populations under No-Till crop system may require extra applications, pulling up costs.

WEED CONTROL

At the start of No-till sunflower planting in Argentina, weed control become a more complex topic. Herbicides for preplant chemical fallow provided effective weed control. Difficulties rose with weeds emerging after planting because two widely used pre-emergence residual herbicides (acetochlor and flurochloridona) were less effective, being dependent of rainfall and retained by stubble.

As a result of research on control programs including other sunflower selective residual herbicides (sulfentrazone, diflufenican, prometrina), combined tank mixes with glyphosate, preplant plus preemergence split applications, etc. (Montoya, 2008) weed control was improved.

Crop preemergence herbicides will always be at some risk of incomplete control because rainfall must move herbicides into the soil prior to weed seed germination. While rescue treatments of escaped grasses are effective, most broadleaf weeds cannot be controlled with postemergence herbicides because the two available (aclonifen and benazolin) are poor performing.

The development of the Clearfield technology (Bojanich, 2003) has been the most important progress for weed control and sunflower No-Till area increase. Trials comparing weed control programs with imazapir applied at V4-V6 were successful (Rodriguez, 2005). Furthermore, since the introduction of CL sunflower hybrids up to date, genetic progress has been important on seed yield, oil content, and high

oleic CL hybrids. For crop sequences in which participate corn and sunflower, CL sunflower usually follows corn, with excellent control of voluntary glyphosate resistant corn (does no control of voluntary CL corn).

FOLLOWING CROP

As compared with corn and soybean, sunflower is an excellent preceding crop for winter cereals and colza, but safety measures must be considered to avoid carryover problems to winter cereals seeded following Clearfield sunflower where imazapyr was applied; colza cannot follow imazapyr applied sunflower. Bioassays have been proposed to detect imazapyr carryover, but are not reliable enough to make crop decisions.

Stalks of a good yielding sunflower may difficult the drilling of the following crop; rolling stalk cutters are widely used, except for areas with wind or water erosion risk.

CONCLUSIONS

Adoption of No-Till systems for sunflower production has found more difficulties than for other crops. Most of them have been attenuated or corrected allowing sunflower to approach 80% No-Till planting adoption in Argentina. Remaining difficulties and emerging adversities will require continuous research and practical solutions to persist and improve sunflower's position as a competitive crop.

REFERENCES

AAPRESID. 2010. Asociación Argentina de Productores en Siembra directa.

<http://www.aapresid.org.ar/index.asp> .

Álvarez, C.R., M. Torres Duggan, E.R. Chamorro, D. D'ambrosio & M. Taboada. 2009. Descompactación de suelos franco limosos en siembra directa: efectos sobre las propiedades edáficas y los cultivos. *Ci. Suelo (Argentina)* 27(2): 159-169.

ASAGIR. 2001. Girasol en siembra directa. V. Pereyra, C. Feoli, y H. Sarlangue (Editores). Cuadernillo Técnico N° 1, 24 p.

ASAGIR. 2007. Actas del 4° Congreso Argentino de Girasol, 29 y 30 de Mayo de 2007, Buenos Aires., Asociación Argentina de Girasol (Editor), 432 p.

Balboa, G.R., G.P. Espósito, C. Castillo y R. Balboa. 2011. Estrategia de fertilización con boro en girasol. IPNI-Fertilizar, Simposio Fertilidad 2011, p.154.

Bojanich, E. 2003. Nueva estrategia de control de malezas en girasol tecnología Clearfield. 2° Congreso Argentino de Girasol, ASAGIR, p. 18-19.

Botta, G.F., D. Jorajuria, R. Balbuena, M. Ressia, C. Ferrero, H. Rosatto & M. Tourn. 2006. Deep tillage and traffic effects on subsoil compaction and sunflower (*Helianthus annuus* L.) yields. *Soil and Tillage Research* 91(1-2): 164-172.

Botta, G.F., A. Tolon-Becerra, X. Lastra Bravo & M. Tourn. 2010. Tillage and traffic effects (planters and tractors) on soil compaction and soybean (*Glycine max* L.) yields in Argentinean pampas. *Soil and Tillage Research* 110(1):167-174.

Díaz-Zorita, M. 2005. Fertilización de Girasol. Cap. 14, p. 301-315, *In Fertilidad de Suelos y Fertilización de cultivos*, H. Echeverría y F. García (Eds.), INTA-INPOFOS, 525 p.

Díaz-Zorita, M. y A. Quiroga. 2007. Manejo de la fertilización: estado actual y novedades. IV° Congreso Argentino de Girasol, ASAGIR, p. 157-167.

Díaz-Zorita, M y M.V. Fernández Canigia. 2010. Fertilización con fósforo y nitrógeno del cultivo de girasol en siembra directa. Actas del XXII Congreso Argentino de la Ciencia del Suelo, AACS, 4 p.

- Faberi, A.J, A.N. López, N.L. Clemente & P.L. Manetti. 2011. Importance of diet in the growth, survivorship and reproduction of the no-tillage pest *Armadillidium vulgare* (Crustacea: Isopoda). *Revista Chilena de Historia Natural* 84: 407-417.
- Ferraris, G.N. 2004. Descompactación de suelos bajo siembra directa continua. EEA Pergamino, *Revista de Tecnología Agropecuaria* 9 (25): 46-48.
- Gonzalez Montaner, J. y M. Di Nápoli. 2000. Diagnostic method of nitrogen fertilization in sunflower crop under different tillage systems in the southeast of Buenos Aires province, Argentina. XV International Sunflower Conference, Toulouse, France.
- Manetti, P., J.C. Ves Losada y E. Teppaz. 2007. Manejo de plagas animales. 4º Congreso Argentino de Girasol, ASAGIR, p. 169-176.
- Murcia, M., A. Peretti, S. San Martino y V. Pereyra. 2001. Vigor de semillas y emergencia a campo de girasol (*Helianthus annuus* L.) en siembras anticipadas en el sudeste de la provincia de Buenos Aires (Argentina). *Revista Brasileira de Sementes* 23(2): 263-267.
- Murcia, M., A. Peretti, S. San Martino, A. Pérez, O. Del Longo, J. Argüello e V. Pereyra. 2002. Vigor e Emeergência em campo de sementes de girassol com alto teor de ácido oleico, no sudeste da provincia de Buenos Aires. *Revista Brasileira de Sementes* 24(1): 129-133.
- Montoya, J.C., C. Porfiri, N. Romano y N. Rodriguez. 2008. Manejo de malezas en el cultivo de girasol. *In* El Cultivo del Girasol en la Región Semiárida Pampeana, INTA EEA Anguil, Publicación Técnica N° 72, p 49-63.
- Pereyra, V. (Coord.). 2002. Taller de Calidad de Semillas de Girasol. Convenio INTA-ASAGIR. Reunión en Balcarce, 23 de Octubre de 2002.
- Quiroga, A., J. Pérez Fernández. 2008. El cultivo del girasol en la región semiárida pampeana. INTA-EEA Anguil, Publicación Técnica N° 72, 112 p.
- Rodriguez, N. 2005. Eficiencia de diferentes alternativas de control de malezas en girasoles Clearsol. INTA-EEA Anguil, Publicación Técnica N° 61, p 125-130.