F. Huggenberger, Austria

TRIFLURALIN FOR WEED CONTROL IN SUNFLOWER

Trifluralin, the first 2.6-dinitroaniline herbicide developed and marketed, is the most widely used herbicide of this class and one of the most important herbicides used selectively in the crops. Although its major use has been in cotton and soybeans, trifluralin has also been used extensively in sunflower and many other crops.

Trifluralin is the common name for α, α, α-trifluoro -2.6-dinitro-N,N-dipropyl-p-toluidine. It is marketed in most countries under the trade name TREFLAN^{R}. Trifluralin is a yellow-orange, crystalline solid with a water solubility of less than 1 ppm. It is volatile with a vapour pressure of 1.03×10^{-4} mm of Hg at 25°C. It is susceptible to decomposition by ultraviolet irradiation. The compound is formulated as emulsifiable concentrates containing 240 g or 480 g trifluralin per litre. It is also available as a 5% w/w granular formulation.

To prevent loss of herbicidal activity by volatilisation and photodegradation, trifluralin has to be incorporated into the soil after application, particularly under climatic conditions with high soil temperatures and prolonged periods of direct sunlight exposure. Trifluralin is strongly adsorbed on soil particles and resists leaching by rain or irrigation. Incorporation is necessary to ensure its effective distribution throughout the depth of soil, where in most circumstances weed seeds germinate. Due to its high vapor pressure trifluralin acts not only dissolved in the soil water, but also in the vapor phase. These physicochemical characteristics assure reliable weed control under adverse conditions of soil moisture and temperature, where surface sprays of many herbicides are not effective (P. Petkova, 1971;

L. Chiapparini, et al., 1974). Establishing a treated zone through incorporation further allows control of resistant weeds by shallow cultivation, rotary hoeing or hand hoeing without reducing the herbicidal efficacy. If applied at the recommended rates trifluralin is degraded within the vegetation period of sunflower and does not affect winter cereals following in the crop rotation (D.S. Vasilyev, M.A. Tsvetkova, 1974).

Trifluralin prevents the germination of susceptible weed seeds. It also inhibits root growth and development of lateral roots in susceptible plant species. It has an inhibitory effect on cell division in meristematic tissue. Normal mitotic cell division is disrupted by preventing microtubule development, the functional parts of the spindle. As a result, cells with nuclei of varying sizes and chromosome content, fragmented chromosomes, other nuclear abnormalities and multinucleate cells develop (I. Corbett, 1974). There is no significant translocation of trifluralin into the stem or foliage of higher plants, nor is it found in the harvested seed crop (G. Klingman, F. Ashton, 1975).

Trifluralin is physiologically selective to sunflower with a wide margin of safety. Application of double the recommended rates did not produce any signs of phytotoxicity to sunflower during the whole growing period (N. Sarpe, P. Tomoroga, 1974).

Application of trifluralin is recommended at rates between 0,6 - 1,2 kg ai/ha according to soil texture and organic matter content. Fine soil texture andsoils with higher content of organic matter require the higher dosages indicated. Trifluralin is not recommended for application on soils with 10% or more organic matter, because of excessive adsorption of the active ingredient in peat and muck soils.

Trifluralin can be applied and incorporated successfully during seedbed preparation, avoiding additional use of farm machinery for incorporation of the product. The tandem disc

is the most widely used equipment to incorporate trifluralin during seedbed preparation. To obtain best results, discing should be carried out in two different directions set to cut 7.5 - 15 cm deep and operated at a speed of 6-10 km/h. The mixing action of the disc is improved by pulling a spike-tooth harrow behind. Trifluralin can be applied and incorporated at any convenient time up to six weeks before seeding sunflower. For maximum herbicidal efficacy and minimum mechanical cost, application and incorporation can be combined into one operation.

Trifluralin provides effective weed control in sunflower throughout the growing season. It is especially active against nearly all annual grass weeds including Digitaria spp., Echinochloa spp. and Setaria spp. Many broadleaf weeds such as Amaranthus spp., Chenopodium spp., Polygonum aviculare, Polygonum convolvulus and Portulaca oleracea are also controlled effectively. Recently there have been several reports confirming excellent results with Trifluralin for weed control in sunflower. Vasilyev et al. (1973) reported that trifluralin with 1 cultivation gave a slightly higher seed yield than 8 cultivations with hand weeding. Trifluralin resistant weeds, Abutilon avicennae, Ambrosia artemisiifolia and Sinapis arvensis were controlled by harrowing soon after crop emergence. N.I. Dvoryadkin (1974) reported weed control of 93-99% with trifluralin followed by 2-3 cultivations. Yields from plots treated with trifluralin were 29-30 c/ha as compared to 25-26 c/ha from plots cultivated 8-10 times without application of a herbicide. D.N. Belevtsev and N.A. Zorin (1974) reported that on fields free from perennial weeds the use of trifluralin allowed the number of interrow cultivations to be reduced from 2-3 to 1.

To control weeds resistant to trifluralin such as Ambrosia artemisiifolia, Hibiscus trionum, Sinapis arvensis and Solanum nigrum,

prometryne or linuron have been applied as surface spray after incorporation of trifluralin and seeding of sunflower. In this spray sequence trifluralin is applied at the full dosage, and prometryne or linuron are applied at reduced rates. Reduction of application rates of prometryne or linuron reduces the risk of crop injury to sunflower following heavy precipitation after application. In areas with mixed infestations of annual grass weeds and broadleaf weeds resistant to trifluralin, the above spray sequence can provide satisfactory weed control, while reducing the risk of crop injury as compared to application of prometryne or linuron alone at dosages sufficient to control grass weeds (J. Beraud, M. Membot, 1974; N. Sarpe, et al., 1973; Y. Regnault, 1974).

References

1. Petkova, P. (1971). Use of trifluralin for weed control in sunflowers. Rasteniev" dni Nauki 8 (7), 157-168.
2. Chiapparini, L., et al. (1974). Résultats des expériences relatives au contrôle des mauvaises herbes dans la culture du tournesol. 6th International Sunflower Conference, 531-544.
3. Vasilyev, D.S.; Tsvetkova, M.A. (1974). The residual effect of herbicides on winter wheat. Khimiya v Sel'skom Khozyaistve 12 (4), 305-306.
4. Corbett, J.R. (1974) in "The biochemical mode of action of pesticides", Academic Press, London, 215.
5. Klingman, G.C.; Ashton, F.M. (1975) in "Weed science principles and practices", John Wiley, London, 194.
6. Sarpe, N.; Tomoroga, P. (1974). Efficiency of herbicides applied alone or combined in the weed control of irrigated or non-irrigated sunflower crops. 6th International

Sunflower Conference, 549-557.
7. Vasilyev, D.S., et al. (1973). Promising agricultural technique for sunflower with the use of highly efficient herbicides. Vestnik Sel' skokhozyaistevennoi Nauki, 6, 34-36.
8. Dvoryadkin, N.I. (1974). Main results in sunflower research in the USSR. 6th International Sunflower Conference, 37-42.
9. Belevtsev, D.N.; Zorin, N.A. (1974). The use of Treflan in sunflower crops in Rostov Province. Khimiya v Sel'skom Khozyaistve 12(8)600-601.
10. Beraud, J.M.; Membot, M. (1974). Trifluralin, alone or combined with a surface treatment for weed control in sunflower in France. Défense des Végétaux 28, 179-192.
11. Sarpe, N., et al. (1973). Contribution al l'étude du desherbage du tournesol cultivé dans diverses conditions pédoclimatiques de Roumanie. 7eme Conference du Columa, 235-239.
12. Regnault, Y. (1974). Le desherbage du tournesol en France. 6th International Sunflower Conference, 545-548.