5th International

WEED SCIENCE CONGRESS

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weeds—local problems global challenge

International Weed Science Society
Weed Science Society of America
Canadian Weed Science Society
European Weed Research Society

2008 Meeting Program

The Westin Bayshore, Vancouver
Vancouver, BC, Canada

23-27 June 2008

At each site the following plant measures were recorded: weed cover at 3 river wide transects, biomass per unit area (5 samples) and the cross sectional area (CSA) of the channel occupied by the plants (central transect only). Discharge and water surface slope were measured. Manning's n, a measure of water impedance by substrate and weeds, was calculated for discharge and slope. Water and sediment samples were taken and analysed for phosphate and available carbon.

Flow impedance (Manning's n) increased with standing crop for all species (*Ranunculus* spp. Rsq adj 63.7% $p < 0.0001$, $n = 16$, *S. erectum* Rsq adj 19%, $p = 0.04$, $n = 17$).

Variations in weed biomass were attributable to latitude for *S. erectum* (Rsq adj 76.5%, $p < 0.0001$, $n = 16$) and not attributable to phosphate or carbon levels in the water. *Ranunculus* spp. biomass was independent of latitude and total soluble carbon but was positively correlated with water soluble reactive phosphate (Rsq adj 47.1%, $p = 0.006$, $n = 12$)

The uncertainty in predictions of water conveyance by channels can be reduced by including measures of weed standing crop. In cases where engineers are unable to visit sites, the latitude and nutrient levels of a site can be used to give an indication of the expected plant growth and associated flow impedance.

The study provides provisional evidence that eutrophication exacerbates flood risk by increasing the density of *Ranunculus* spp. but this process does not apply to the emergent weed, *S. erectum*.

739. **An Ecological Approach to Aquatic Plant Management.** Michael Smart[1], Michael Grodowitz[1]; [1]US Army Corps of Engineers, Lewisville, TX, United States of America

Nonindigenous aquatic weeds frequently occur in large monospecific beds, particularly in man-made, water resources projects such as multipurpose reservoirs and waterways. These large infestations cause major problems for users of water resources. Traditional management approaches using herbicides, drawdown, or the stocking of herbivorous fish, can be effective, but typically provide only short-term results. In addition, these methods can be very expensive and typically leave an empty niche that can contribute to other problems such as algal blooms or is rapidly filled with either the same or another nonindigenous.

A simple, yet often used concept of integrated pest or plant management (IPM) is one where all available management options are considered as part of a toolbox or arsenal. These tools/weapons are then used singly or in combination in an effort to maximize control without impacting the use of one or more strategies. While this approach can be effective it, too, tends to provide only short-term control by neglecting the underlying reasons for the formation of the infestations. A more prudent and ecologically compatible approach would be the use of an ecosystem-based IPM program that relies heavily on ecosystem management and restoration strategies and addresses causative factors that contribute to such formations.

A key component of an ecosystem approach to managing aquatic plants is the use of host-specific biological control agents. Most of the economically important invasive/nuisance aquatic plants are introduced species that have escaped their host-specific herbivores and pathogens. In addition to their high intrinsic rates of increase this lack of sustained feeding and resultant damage allows the formation of extensive monospecific infestations. A second key component is the establishment of a diverse community of native aquatic plants. These plants fill the empty niche and provide competitive pressure to deter, or at least delay, recovery of nonindigenous, weedy species. By introducing a complex of host-specific herbivores and pathogens and re-establishing competitive native aquatic plants as part of an ecologically based IPM program, populations of nonindigenous weedy species can be held at non-problem levels. In addition, this approach increases the environmental and ecological value of the water body while providing a sustainable solution to the problem of nonindigenous weed infestation. Several case studies using this ecological approach will be presented.

740. **Integrated Weed Management Systems in Vegetables: Current Status and Perspectives.** Francesco Tei[1], Euro Pannacci[1]; [1]University of Perugia, Perugia, Italy

Most vegetable crops are characterised by a low plant density, a wide row distance, a slow initial growth and, as a consequence, by a poor competitive ability. Taking into consideration that most vegetables are high-income crops, the threshold weed densities are very low and the critical periods of weed competition are pretty long. Most vegetables are minor crops, thus the availability of approved herbicides for use is scarce due to the low economic interest by the chemical industries. Special projects for supporting the registration of pest control products on minor or specialty crops (e.g. the IR-4 in USA) or for coordinating scientific and regulatory decisions on pesticides were established to alleviate the problem. In EU the already difficult situation has been worsening by the application of the directive 91/414/EEC concerning the authorization, placing on the market, use and control of plant protection products in commercial form. This directive has already caused the expiration of the authorisation of several herbicides largely used in vegetables and other ones will be withdrawn within few years. Chemical weed control in vegetables shows peculiar environmental and health concerns due to the relatively short growth cycle, fresh edible parts of vegetables, and a coarse soil texture found in the main production areas; moreover, a repeated use of herbicides with similar mode of action may lead to a strong and quick selection of weed flora. So an Integrated Weed Management System (IWMS) in vegetables, like in any other crops, should be based on: 1) weed population management strategies by sound cultural weed control methods, i.e. any aspect of crop management that favours the crop relative to the weeds, reduces the weed seed-bank, regulates weed communities and prevents the build-up of adapted species; 2) an integration of non-chemical and chemical weed control methods characterised by a low selection pressure on weed communities, an environmental sustainability and an economic feasibility.

Regarding preventive (indirect) weed control methods, it should be pointed out that: although the crop rotation was crucial for an IWM, in practice a sound crop rotation frequently is not applied due to economic and market constraints; the strategic importance of the cover crops seems low in environments characterised by limited availability of irrigation water or high water cost; intercropping, thanks to new technical solutions for mechanical harvest, is increasing in interest in organic and low input farming systems; a stale seedbed preparation is widely applied in several vegetable crops throughout the world; the breeding of competitive cultivars is not yet enough developed even if experimental results seem to be encouraging; the transplanting instead of the direct sowing is commonly applied in order to give a higher competitive ability to the crop, shorten the critical period of competition and facilitate direct weed control; the increase of crop plant density and the adoption of a narrower row distance or twin rows in order to increase the crop competitivity offers interesting applications but in some crops the cost of transplants, the negative effects of a higher crop density on quality product and the need to have well-spaced crop rows for the application of mechanical weed control limit the use of those cultural practices; the effect of different localised fertilisation and/or irrigation methods (e.g. starter fertilisation, band fertilisation, fertigation) on crop competitive ability against weeds should be better studied.

Regarding curative (direct) weed control methods: non-degradable black PE mulches are widely used in several vegetable crops; non-degradable photo-selective coloured plastic mulches, that combine the thermal properties of transparent films with the weed control ability of black films, show a good efficacy but not always an economic feasibility; starch-based biodegradable mulches are more and more used both in conventional and organic farming systems where they show a mulching activity for 2-4 months, that is enough to cover the critical period of competition of most vegetable crops; inter-row weeds are easily removed by inter-row cultivation (i.e. hoeing, harrowing, brushing) while intra-row weeds still constitute a major challenge aimed at minimising laborious hand weeding although new implements (i.e. finger weeder, torsion weeder, split hoe, steering hoe) show a pretty good efficacy if their application is included in a sound IWM programme; physical and mechanical weed control methods are widely used in organic farming systems and in conventional systems where the availability of approved herbicides for use is scarce; at present, biological control does not seem to be applicable on large scale and successfully in European vegetable crops systems characterised by small fields, a high number of crop species, and pluri-specific weed infestations; chemical control still is the main weed control method in conventional and low input vegetable production systems even if concerns about food safety, environmental sustainability, weed population dynamics and application cost are increasing among public opinion and technicians, particularly because the global market shows a huge variability in crop management and regulatory decisions on pesticides.

741. **Autumn Vegetable Response to Residual Terbacil, Fomesafen, and Halosulfuron.** Timothy Grey[1], Stanley Culpepper[1]; [1]University of Georgia, Tifton, GA, United States of America

Field studies were conducted to evaluate autumn planted crop tolerance to residual herbicides applied in the previous cotton crop or vegetable crop either the previous summer to bare-soil or the previous spring to soil under low density polyethylene mulch (LDPE). Experiments conducted in 2006-2007 and 2007-2008 included summer post directed applications to bare-soil of 0.17 and 0.34 kg/ha terbacil, 0.28 and 0.56 kg/ha fomesafen, and 0.053 and 0.11 kg/ha halosulfuron in cotton during made in July of each year and included a nontreated control. After removal of a cotton crop, autumn vegetables were planted in November 2006 and October 2007 and included transplanted kale, broccoli, cabbage, and collard (all *Brassica oleracea*). No injury was observed in 2006-2007 but severe injury was noted during 2007-2008. However, in 2007-2008 at 48 days after planting and 147 days after treatment, terbacil injured kale 26 to 53%, broccoli 25 to 53%, cabbage 41 to 93%, and collard 28 to 45%. Fomesafen injured kale 55 to 75%, broccoli 43 to 73%, cabbage 70 to 90%, and collard 43 to 79%. Cabbage exhibited the greatest injury with reductions in stand from crop death from fomesafen and terbacil. Injury from halosulfuron carryover diminished over time. No injury was observed for the 2006-2007 bare-soil experiment for any crop. Rainfall was greater between application timing and vegetable planting for 2006-2007 (33.8 cm) verses 2007-2008 (21.8 cum) which could have increased dissipation and resulted is less potential for injury. For the LDPE mulch experiments, 0.28 and 0.56 kg/ha fomesafen and 0.56 kg/ha fomesafen plus 0.8 kg/ha S-metolachlor was spray applied to soil prior to covering with (LDPE) in February 2007, and included a nontreated control. After summer vegetable crop removal, August transplanting of