Proc. Fla. State Hort. Soc. 118:163-165. 2005.

EFFECTS OF TIME OF EMERGENCE ON YELLOW AND PURPLE NUTSEDGE AREA OF INFLUENCE IN BELL PEPPER

BIELINSKI M. SANTOS,* JAMES P. GILREATH,
CAMILLE E. ESMEL AND MYRIAM N. SIHAM
University of Florida, IFAS
Gulf Coast Research and Education Center
14625 County Road 672
Wimauma, FL 33598

Additional index words. *Capsicum annuum*, *Cyperus rotundus*, *Cyperus esculentum*, weed interference, competition, duration of interference

Abstract. **Field trials were conducted to determine the effect of yellow and purple nutsedge (*Cyperus esculentum* L. and *C. rotundus* L.) time of emergence on the area of influence of each weed on bell pepper (*Capsicum annuum* L.). A single weed was transplanted 1, 2, 3, 4, and 5 weeks after bell pepper transplanting (WAT) and bell pepper yield was collected at 0, 30, 60, and 90 cm from each weed. Bell pepper yield data indicated that yellow nutsedge was more aggressive than purple nutsedge interfering with bell pepper. When yellow nutsedge emerged 1 WAT, bell pepper yield losses were between 57 and 32% for plants at 0 and 30 cm away from the weed, respectively, which represents at least a density of approximately 3.5 plants/m^2. For purple nutsedge, one weed growing since 1 WAT between two bell pepper plants (0 cm; 10 plants/m^2) produced a yield reduction of 31%. These results indicated that low nutsedge densities, which are commonly believed to be unimportant, can cause significant bell pepper yield reductions.**

Bell pepper is among the leading vegetable crops in the US. During 2004, this crop produced a gross value of more than $570 million and was planted in approximately 23,000 ha (USDA, 2005). In Florida, bell pepper is only second to tomato (*Lycopersicon esculentum* Mill.) in total value, representing nearly $218 million (USDA, 2005).

Yellow and purple nutsedge interference in polyethylene-mulched bell pepper can cause significant yield reductions. Gilreath et al. (2005a) found that bell pepper yield reductions reached 31% with a nutsedge density of approximately 50 plants/m^2 during fruit setting. During the last two decades, nutsedge species have been effectively controlled with methyl bromide (MBr) fumigation before placing plastic films. However, MBr is being phased out because it is an ozone-depleting substance (US-EPA, 1999). Thus, a great deal of research is being conducted to find suitable replacements for MBr in mulched vegetable crops.

Currently, the leading MBr alternatives have proven to be effective against soilborne diseases and nematodes. Direct preplant in-bed injections of the combination of 1,3-dichloropropene (1,3-D) and chloropicrin (Pic) have shown to be effective to reduce Fusarium wilt (*Fusarium oxysporum* Schlecht. f.sp. *lycopersici* Snyder & Hansen) incidence and root-knot (*Meloidogyne* spp.), stunt (*Tylenchorhynchus* spp.), ring (*Criconemoides* spp.), and sting (*Belonolaimus* spp.) nematode populations (Jones et al., 1995; Gilreath et al., 2005b). Other soil fumigants need excessively high concentrations and rates to control nutsedges. Previous studies have indicated that metam potassium, methyl iodide, propylene oxide, and dimethyl disulfate are effective against soilborne diseases and nematodes, but do not sufficiently reduce nutsedge incidence at recommended rates, resulting in low initial densities on the planting beds (Gilreath et al., 2004a, b; López-Aranda et al., 2004; Santos and Gilreath, 2004). All this is further complicated because there are no effective postemergence herbicides registered for nutsedge control in Florida bell pepper (Stall and Gilreath, 2003).

Under practical field situations, low nutsedge densities are considered unimportant. However, previous research has stressed the importance of low densities on crops by studying the weed area of influence (Motis et al., 2001). The area of influence methodology is a powerful tool to determine the impact of a single weed plant at varying distances on crop growth and yield (Oliver and Buchanan, 1986; Santos et al., 2004). Jordan (1989) explained in details the biological and statistical concerns of this type of studies. This methodology requires somewhat complicated data collection, analysis and interpretation procedures, where multivariate analysis of variance (MANOVA) must be applied, instead of the frequently-used analysis of variance (Jordan, 1989).

It is well known that the extent of yield reduction, as well as other factors such as fruit quality and maturity, depends on the length of weed interference (Radosevich, 1987). Direct field observations of most MBr alternatives in mulched bell pepper suggests that nutsedge sprouting at low densities occurs during the initial weeks after crop transplanting (WAT). However, there are no reports on the effect of nutsedge time of emergence on its area of influence in bell pepper. Therefore, the objective of this study was to determine the area of influence of yellow and purple nutsedge as affected by their time of emergence in polyethylene-mulched bell pepper.

Materials and Methods

Field trials were conducted during two consecutive bell pepper seasons in 2002 and 2003 at the Gulf Coast Research and Education Center of the University of Florida in Bradenton, Fla. Bell pepper planting beds were 81 cm wide at the base, 71 cm wide at the top, 20 cm high, and spaced 1.5 m apart on centers. Finished beds were fumigated with methyl bromide plus chloropicrin (67:33 v/v) at a rate of 390 kg·ha^{-1} to eliminate all soilborne disease, nematode and weeds in the soil. Immediately after fumigation, each bed was fertilized according to crop requirements and soil nutrient concentrations. Planting beds were covered with black low density polyethylene mulch. Simultaneous with film covering, drip irrigation tubing (T-Tape Systems Intl., San Diego, Calif.) was placed 2.5 cm deep down the bed center under the film. Irrigation was supplied daily via drip irrigation. According to local crop recommendations, additional N and K were supplied to the crop through the drip lines (Maynard et al., 2003). ‘Capistrano’ pepper seedlings were transplanted 30 cm apart within each of 2 rows per bed with 30 cm between rows three

*Corresponding author; e-mail: bmsantos@ifas.ufl.edu

weeks after fumigation. Beginning at one week before bell pepper transplanting, twelve yellow and purple nutsedge tubers from nearby fields were collected and planted in 0.5-L containers filled with a commercial potting medium. This procedure was repeated for 5 weeks to ensure supplying one-week old nutsedge plants for the trials.

Experimental units contained twenty bell pepper plant pairs, which were divided in half for each nutsedge species. A single nutsedge seedling was transplanted in the middle of each subplot, equidistant from each bell pepper row at five weed emergence times (1, 2, 3, 4, and 5 WAT). Undesired volunteer nutsedge plants, as well as other weeds, were removed by hand on bed tops and row middles. Treatments were arranged in a split-plot design with six replications. The nutsedge species were the main plots, whereas times of weed emergence were the subplots.

Within each subplot, bell pepper yield was obtained by harvesting pairs of plants from each row at along-the-row distances of 0, 30, 60, and 90 cm from their respective nutsedge plant. The crop was harvested four times beginning at 10 WAT. Average fresh weights for each distance were analyzed for nutsedge species and time of emergence effects ($P = 0.05$) by using the Wilks' Lambda statistic calculated by the MANOVA procedure (Jordan, 1989). Standard errors were used to separate treatment means.

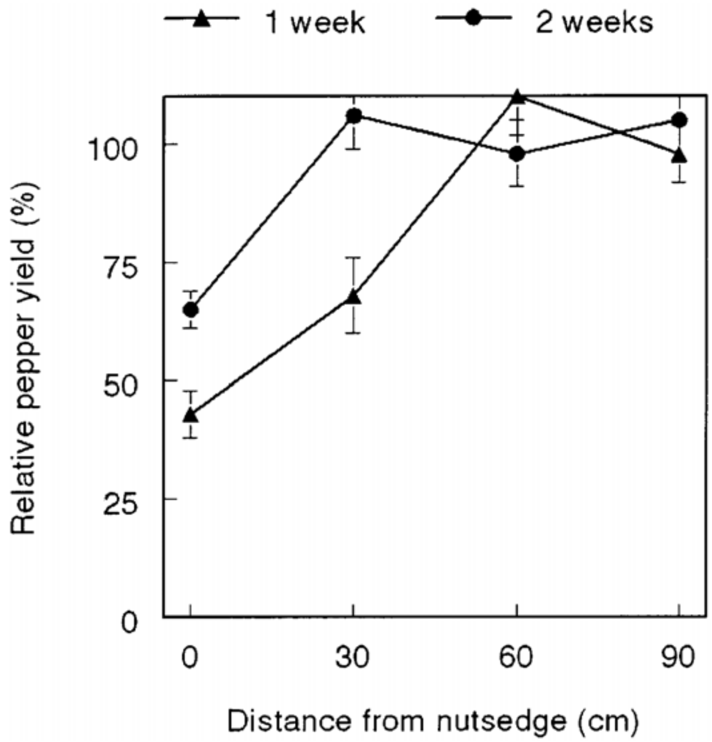

Fig. 1. Effect of yellow nutsedge (*Cyperus esculentus*) distance and time of emergence on bell pepper relative yield. Bradenton, 2004.

Results and Discussion

There was no significant season by treatment interaction. Therefore, data from only one season (2004) are discussed. The interaction between nutsedge species and time of emergence affected bell pepper yield. Thus, each combination will be discussed separately. For yellow nutsedge, there was significant time of emergence effect on the area of influence in bell pepper. However, bell pepper yield reductions occurred only when the weed was established at 1 and 2 WAT. At one week, yellow nutsedge impact on bell pepper yield decreased as distance increased from 0 to 60 cm (Fig. 1). Crop yield reductions reached 57 and 32% when the weed grew at 0 and 30 cm from the bell pepper plants, respectively. This harmful effect disappeared at 60 cm and farther. At 2 WAT, only the yellow nutsedge growing at 0 cm caused 35% bell pepper yield reduction, with no effect at 30 cm of further.

In contrast with yellow nutsedge, only purple nutsedge plants established at 1 WAT caused significant bell pepper yield reductions (Fig. 2). At 0 cm from the weed, the crop fresh fruit weight declined 31%, whereas there was no difference between the weed-free control and the yields of bell pepper plants growing at 30 cm or more from purple nutsedge.

These results indicated that low nutsedge densities, which are commonly believed to be unimportant, can cause significant bell pepper yield reductions, especially if the weeds emerge early during the growing season. For example, a single yellow nutsedge plant growing 30 cm away from bell pepper plants represents an approximate density of 3.5 plants per m^2, whereas for purple nutsedge, one weed plant growing between two bell pepper plants in double rows results in a density of about 10 plants per m^2.

In relative terms, these findings showed that yellow nutsedge is more aggressive than purple nutsedge against bell pepper. Santos et al. (1997b) suggested that under greenhouse conditions, yellow nutsedge was a better competitor than purple nutsedge against tomato. This increased competitive ability can partly be explained by the lower light compensation point that yellow nutsedge possesses with respect to purple nutsedge, allowing the former to endure successfully shading conditions (Santos et al., 1997a). In this case, a single yellow nutsedge plant emerging 2 WAT could still reduce bell

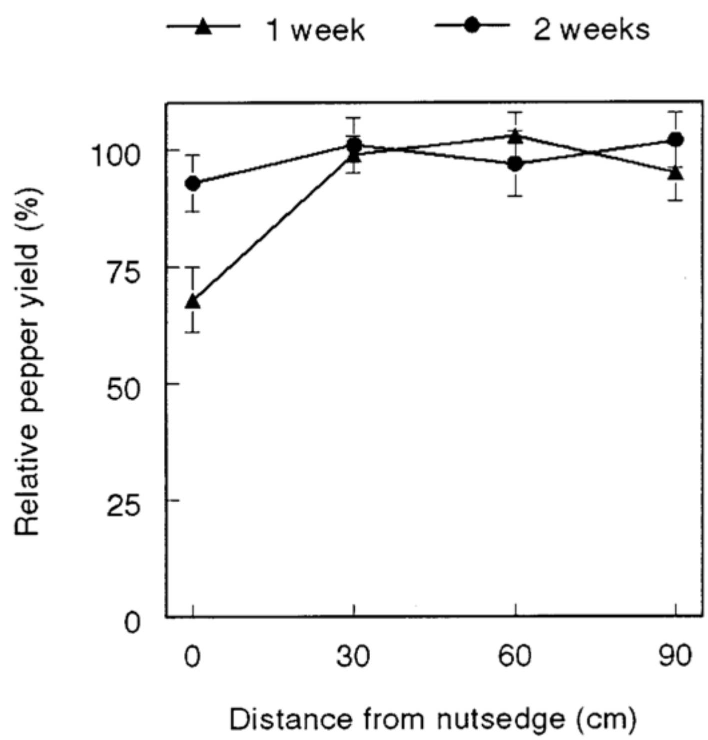

Fig. 2. Effect of purple nutsedge (*Cyperus rotundus*) distance and time of emergence on bell pepper relative yield. Bradenton, 2004.

pepper fruit weight, whereas at the same time purple nutsedge had no effect on the crop.

Literature Cited

Gilreath, J. P., B. M. Santos, and J. W. Noling. 2004a. Effective rate of propylene oxide for nutsedge control, p. 21-1. In 2004 Annu. Intl. Res. Conf. Methyl Bromide Alternatives Emissions Reductions. Orlando, Fla., Oct. 30-Nov. 3, 2004. Methyl Bromide Alternatives Outreach. Orlando, Fla. http://mbao.org.

Gilreath, J. P., B. M. Santos, and J. W. Noling. 2004b. Purple nutsedge control with iodomethane, pp. 51-1-2. In 2004 Annu. Intl. Res. Conf. Methyl Bromide Alternatives Emissions Reductions. Orlando, Fla., Oct. 30-Nov. 3, 2004. Methyl Bromide Alternatives Outreach. Orlando, Fla. http://mbao.org.

Gilreath, J. P., T. N. Motis, and B. M. Santos. 2005a. *Cyperus* spp. control with reduced methyl bromide plus chloropicrin doses under virtually impermeable films in pepper. Crop Prot. 24:285-287.

Gilreath, J. P., T. N. Motis, B. M. Santos, J. W. Noling, S. J. Locascio, D. O. Chellemi. 2005b. Resurgence of soilborne pests in double-cropped cucumber after application of methyl bromide chemical alternatives and solarization in tomato. HortTechnology 15:(in press).

Jones, J. P., J. P. Gilreath, and A. J. Overman. 1995. Control of soil-borne disease of mulched tomato by fumigation. Proc. Fla. State Hort. Soc. 108:201-203.

Jordan, N. 1989. A statistical analysis for area-of-influence experiments. Weed Technol. 3:114-121.

López-Aranda, J. M., L. Miranda, C. Soria, F. Romero, B. de los Santos, F. Montes, J. M. Vega, J. I. Páez, J. Bascón, and J. J. Medina. 2004. Chemical alternatives to methyl bromide for strawberry production in Huelva (Spain), 2003-04 results, pp. 41-1-4. In 2004 Annu. Intl. Res. Conf. Methyl Bromide Alternatives Emissions Reductions. Orlando, Fla., Oct. 30-Nov. 3, 2004. Methyl Bromide Alternatives Outreach. Orlando, Fla. http://mbao.org.

Maynard, D. N., G. J. Hochmuth, C. S. Vavrina, W. M. Stall, T. A. Kucharek, S. E. Webb, T. G. Taylor, S. A. Smith, E. H. Simonne, and S. M. Olson. 2003. Pepper production in Florida, pp. 223-232. In S. M. Olson and E. H. Simonne (eds.). Vegetable production guide for Florida. IFAS Publ., Gainesville, Fla.

Motis, T. N., S. J. Locascio, and J. P. Gilreath. 2001. Yellow nutsedge interference effects on fruit weight of polyethylene-mulched bell pepper. Proc. Fla. State. Hort. Soc. 114:268-271.

Oliver, L. R. and G. A. Buchanan. 1986. Weed competition and economic thresholds, pp. 71-91. In N. D. Camper (ed.). Research methods in weed science. South. Weed Sci. Soc.

Radosevich, S. R. 1987. Methods to study interactions among crops and weeds. Weed Technol. 1:190-198.

Santos, B. M. and J. P. Gilreath. 2004. Purple nutsedge (*Cyperus rotundus*) control with drip-applied metam potassium. Proc. Fla. State Hort. Soc. 117:15-17.

Santos, B. M., J. P. Morales-Payan, W. M. Stall, T. A. Bewick, and D. G. Shilling. 1997a. Effects of shading on the growth of nutsedges (*Cyperus* spp.). Weed Sci. 45:670-673.

Santos, B. M., T. A. Bewick, W. M. Stall, and D. G. Shilling. 1997b. Competitive interactions of tomato (*Lycopersicon esculentum*) and nutsedges (*Cyperus* spp.). Weed Sci. 45:229-233.

Santos, B. M., J. A. Dusky, W. M. Stall, and J. P. Gilreath. 2004. Effects of phosphorus fertilization on the area of influence of common lambsquarters (*Chenopodium album*) in lettuce. Weed Technol. 18:258-262.

Stall, W. M. and J. P. Gilreath. 2002. Weed control in pepper, p. 39-42. In: W. M. Stall (ed.). Weed management in Florida fruits and vegetables, 2002-2003. IFAS-Univ. of Fla., Gainesville.

[USDA] U.S. Department of Agriculture. 2005. Vegetables: Acreage, production and value. 14 Feb 2005. <http://www.nass.usda.gov>.

[US-EPA] U.S. Environmental Protection Agency. 1999. Protection of stratospheric ozone: Incorporation of Montreal protocol adjustment for a 1999 interim reduction in Class I, Group VI controlled substances. Fed. Register 64:29240-29245.