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Item No. 1 of 1

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INVESTIGATOR: Regnier, E. E.; Harrison, S. K.; Metzger, J. D.; Bennett, M. A.

PERFORMING INSTITUTION:

Horticulture and Crop Science
OHIO STATE UNIVERSITY
1680 MADISON AVENUE
WOOSTER, OHIO 44691

RENEWABLE MULCHES FOR INTEGRATED WEED MANAGEMENT IN SMALL-SCALE CROP PRODUCTION

NON-TECHNICAL SUMMARY: The goal of this Research Project is to develop an integrated weed management strategy for sustainable, organic cropping systems tailored to small-scale growers in urban and peri-urban environments. We will explore the potential to create effective mulches from pure preparations and mixes of shredded recycled newspaper and dried cover crop residues that can be grown on site. Our objective is to develop mulches using readily available materials and tools, that can be easily spread on the soil surface (i.e., around growing vegetables), and, which, after wetting, bond to themselves to create an impenetrable barrier against weeds. Shredded newspaper, when wetted, has been shown in previous research to have this tendency, but it is not known how to prepare a mulch to ensure that the mulch fragments will bond to each other, creating a solid barrier. We will determine the influence of different preparation methods on mulch cohesion including the width and length of mulch fragments and the amount and force of watering the mulch after it is spread on the soil. We will also determine if mixing shredded newspaper with plant residues that naturally suppress weeds through the release of chemicals that are toxic to germinating weeds (i.e., allelochemicals) increases weed control compared to newspaper alone. In addition, we will determine to what depth mulches need to be applied to control annual and perennial weeds that emerge from organs of different types and sizes (i.e., seeds, tubers, bulbs, etc.) so that appropriate mulch rates can be selected according to the types of weeds present. Mulches of different composition and with different physical characteristics can influence permeability to water and thus soil moisture, the spread of fungal spores to crop leaves through rain splash from the soil surface, and the availability of soil nutrients for crop growth as mulches are decomposed by soil microorganisms, which consumes nutrients. We will test the effect of mulches prepared from different materials on their overall effects on the growth of vegetables, including heirloom tomato, Edamame soybean, and sweet potato. These species have different growth habits (upright, trellised, or spreading), nutrient needs, and susceptibility to disease. Finally, we will do a budget analysis to determine the most cost-effective mulches, considering the costs of preparing, applying, and weeding (if needed) the mulches, and the expected return from crop sales. Our expected outcomes are 1) development of new sustainable, cost-effective, and user-friendly weed control strategies; 2) an improved scientific understanding of the physical characteristics required for a mulch to prevent weed emergence; and 3) the development of guidelines for the small farmer on how to prepare and apply mulches at a minimum cost to achieve good weed suppression and also build soil quality.

OBJECTIVES: The goal of this Research Project is to develop an integrated weed management strategy for sustainable, organic cropping systems tailored to small-scale growers in urban and peri-urban environments.

We will explore the potential to create effective mulches from pure preparations and mixes of recycled newspaper and plant residues grown on site, using readily available materials and tools. We will test these methods on suppression of weed species that vary in seed and/or propagule (e.g., tuber, bulb, rhizome) size. Our objectives are to 1) determine the influence of mulch preparation methods on the effectiveness of recycled newspaper and plant residues to prevent weed emergence, 2) determine the influence of newspaper and plant residue mulches on crop productivity and soil characteristics, and 3) determine least-cost mulch systems. Our expected outcomes are 1) development of new sustainable, cost-effective, and user-friendly weed control strategies; 2) an improved understanding of the physical characteristics required for a mulch to prevent weed emergence; and 3) the development of guidelines for the small farmer on how to prepare and apply mulches at a minimum cost to achieve good weed suppression and also build soil quality.

APPROACH: Objective 1. Greenhouse experiments will be conducted with newspaper and cover crop residues to determine the influence of mulch preparation on mulch cohesion and resistance to weed emergence. Mulch fragment size and shape, method of mulch mixing, wetting, and proportion of newspaper to cover crop residue will be evaluated. Cool and warm-season cover crops will be evaluated. Mulch cohesion, permeability to light, and weed suppression will be determined using a single test weed species. The most promising mulches will be advanced for further study in field experiments to determine the effect of mulch type and application rate on emergence from different weed seed/propagule sizes. The number of emerged shoots and the shoot length from the soil surface to the mulch surface will be recorded. The ratio of the shoot length to the mulch depth will be used as an index of mulch resistance to emergence (the greater the ratio, the more obstructive the mulch). Data will be analyzed by mixed model ANOVA and regression analysis to determine the mulch physical characteristics associated with weed suppression, and the effect of mulch application rate on suppression of weeds as a function of propagule mass. Objective 2. Three mulches will be selected from the previous experiments to determine their effects on crop growth and productivity, weed control, and soil properties. The experiment will evaluate crop species that differ in growth habit (upright, trellised, spreading), nitrogen fixation, portion harvested, and disease susceptibility. Weed control, crop productivity, and disease incidence will be determined. Time spent applying the mulches, managing the crop plants, weeding, and harvesting will be recorded. Mulches will be incorporated into the soil following harvest and the soil analyzed for pH, N, P, K, micronutrients, and soil organic matter. Data will be analyzed by mixed model ANOVA and means will be separated by pairwise t-tests. Objective 3. A partial budget analysis will be used to compare the cost effectiveness of weed control treatments. Costs due to the various treatments will be calculated and all variable and fixed costs associated with crop production will be assumed to be equal. The cost of each weed control treatment will be based on the materials used, the labor required, and use of machinery. For mulches grown on site, all production costs will be included. Gross crop values (GCVs) will be calculated by multiplying crop yield by the wholesale price. Adjusted crop values will be calculated by subtracting the cost of each treatment from GCVs. The adjusted values will provide an index of the relative cost effectiveness of the treatments.

PROGRESS: 2010/08 TO 2011/07

OUTPUTS: Small-scale urban agriculture production has become increasingly prevalent in the developing world and more recently in the United States, due in part to an increased availability of abandoned property in urban areas and demand for locally grown products. The principle means of weed management on urban farms are hand weeding or mulching. A variety of mulches can be utilized, such as plastic, wood chips, repurposed plant material, and paper. End rolls of newspaper are readily available from newspaper printing facilities, are easy to install, and are biodegradable. Little research has been done on the effects of a combined use of paper and plant residues as mulches. Combining these treatments could increase weed suppression by filling gaps left by degraded leaves, and could also lower the C:N ratio by including higher N residues below the mulch barrier. A field experiment was conducted to determine the effects of mulches composed of newspaper with or without cover crop residues on weed emergence, soil properties, and collard green performance. Mulch treatments were newspaper, black plastic, cover crop residues, newspaper plus cover crop residue, black plastic plus cover crop residue, and a no-mulch control. The short-season cover crop treatment consisted of a mixture of cowpeas and buckwheat. Cowpeas were selected for their low plant tissue C:N ratio and symbiotic relationship with nitrogen fixing bacteria. Buckwheat, classified as a smother crop, was selected for its ability to scavenge and release phosphorus in a plant usable form. Cover crops were planted on June 7, 2011 and flattened and killed August 2, 2011 using an under-cutter

with a roller attachment. Plastic and newspaper were individually rolled on top of the flattened cover crops and tacked into place using ground staples. Weed populations were highest in the no-mulch treatment and lowest in the plastic treatment. Newspaper end rolls degraded the most followed by newspaper plus cover crop residue. Marketable yields were lowest in the no mulch treatment, and highest in the newspaper plus cover crop treatment. Results indicate that the newspaper plus cover crop residue treatment was effective in suppressing weeds, and enhancing crop performance when compared to other treatments. PARTICIPANTS: Nothing significant to report during this reporting period. TARGET AUDIENCES: Scientists, consultants, growers, educators, non-governmental organizations, and students PROJECT MODIFICATIONS: Nothing significant to report during this reporting period.

IMPACT: 2010/08 TO 2011/07

Sheets of polyethylene plastic mulch are commonly applied to the soil surface of horticultural crop production fields to reduce weed pressure and boost crop productivity. The findings from these studies revealed that renewable, organic mulches can potentially be a suitable replacement for non-renewable plastic mulches. Mulch treatments applied to the soil surface of bedded rows of collard included newspaper sheeting, black plastic, undercut cover crop residue of cowpea and buckwheat, newspaper plus cover crop residue, black plastic plus cover crop residue, and a no-mulch control. Weed populations were highest in the no-mulch treatment and lowest in the plastic treatment. Newspaper sheets degraded fastest, followed by newspaper plus cover crop residue. Marketable collard yields were lowest in the no mulch treatment, and highest in the newspaper plus cover crop residue treatment. Results indicate that the newspaper plus cover crop residue treatment was effective in suppressing weeds, and enhancing crop performance when compared to other treatments. These findings represent a change in our knowledge of crop response to mulches consisting of mixed strata of renewable, organic materials in comparison with the industry standard, non-renewable plastic mulch, and provide practical information to crop producers interested in organic, renewable methods of crop production.

PUBLICATIONS (not previously reported): 2010/08 TO 2011/07

1. Splawski, C., E. E. Regnier, S.K. Harrison, M.A. Bennett, and J. D. Metzger. 2011. Mulch effects on pumpkin and pollinator (*Peponapis pruinosa*) performance. Proc. North Cent. Weed Sci. Soc. 66:95.
2. Read, N.A., E. E. Regnier, S. K. Harrison, J.D. Metzger, and M.A. Bennett. 2011. Plant residues and newspaper mulch effects on weed emergence and crop performance. Proc. North Cent. Weed Sci. Soc. 66:119.

PROJECT CONTACT:

Name: Regnier, E. E.
Phone: 614-292-8497
Fax: 614-292-7162
Email: regnier.1@osu.edu