Urban Conservation Agriculture with Vegetables

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Introduction

Vegetables are important sources of vitamins and nutrients for human nutrition. USDA recommends filling half of the food plates with vegetables in every meal. While it is important in promoting good health, access to fresh vegetables is limited especially in urban dessert communities. Conservation agriculture (CA) with vegetables (Figure 1) may be a solution to the food desert problems in the US as well as in other communities worldwide with limited access to fresh vegetables. This may be done by converting part of the lawns or impervious surfaces to vegetable production through CA. CA could prove attractive to homeowners by having fresh vegetables and also by reducing their inversion or tilling of soil to control weeds and soil moisture retention by the presence of continues mulch that controls weeds and diverse species rotations that potentially limits the insect, pests and diseases (Figure 2). This poster exhibits the results of three years vegetable yield results of converting part of a lawn into conservation agriculture vegetable plots.

Methodology

A lawn at Sockwell Hall, North Carolina A&T State University was converted into a vegetable production area comparing till, no-till, CA-Summer (Vegetables in all seasons except summer) and CA-Winter (Vegetables in all seasons except winter) (Figure 3). CA treatments when not planted with vegetables are planted with covercrops. Soil were imported to the site due to having a shallow soil depth. It was probably a part of a parking lot before it was used as turf lawn. Vegetable beds were designed to be like the size of house sofa's as such it is called oasissofa's. All plots were irrigated with drip irrigation and supplemented with sprinkler irrigation from the rain water harvesters. All plots were fertilized the same as well.

Figure 1.Urban Conservation Agriculture or Oasissofa's

Figure 2. Principles of Conservation Agriculture
Taken from Edralin et al., 2012. Conservation Agriculture in Urban Deserts. Presented as poster in SSSA meeting, Cincinnati Ohio.

Treatments

1. Tilled (Continuous turning over of soil no residue retention)
2. No-till (No-tilling of soil with residue retention)
3. CA-Winter (Vegetables in all seasons except winter)*
4. CA-Summer (Vegetables in all seasons except summer)*

_* Cover crops are planted during times not planted with vegetables

Experimental design

Randomized complete block design with 4 replications

Figure 3. Turf lawn converted to Urban Vegetable Conservation Agriculture

Figure 4. Urban Vegetable Conservation agriculture summer 2012 and 2013

Results and Discussion

Table 1. Fall 2011 Vegetable Yield.

Vegetables	Yield (kg m^{-2})
Broccoli	2.72
Lettuce	1.55
Collar greens	1.67
Kale	1.02

Table 2. Winter – Spring 2012 Vegetable Yield.

Vegetables	Yield (kg m^{-2})
Asian greens	1.11
Lettuce	0.94
Spinach	0.97
Snow pea	0.66

Table 3. Summer 2012 Vegetable Yield.

Vegetables	Treatment Yield (kg m^{-2})	
	With Cover crop	No Cover crop
Celebrity tomato	10.91	9.56
Cherry tomato	8.30	12.05
Eggplant	3.76	5.38
Okra *	1.70 ^{b}	4.46 ^{a}

*Means under each vegetable having different letters are not significantly different at 5% level of significance as indicated by Fisher's protected LSD test.

Table 4. Fall 2012 Vegetable Yield.

Vegetables	Treatment Yield (kg m^{-2})		
	Conservation Agriculture Summer	No - till	Tilled
Lettuce	0.80	0.73	0.61
Collard greens *	0.87 ^{a}	0.68 ^{b}	0.55 ^{b}

*Means under each vegetable having different letters are not significantly different at 5% level of significance as indicated by Fisher's protected LSD test.

Table 5. Summer 2013 Vegetable Yield.

Vegetables	Treatment Yield (kg m^{-2})		
	Conservation Agric Winter	No - till	Tilled
Tomato *	9.4 ^{a}	6.67 ^{b}	6.43 ^{b}
Pepper	7.41	6.47	5.85

*Means under each vegetable having different letters are not significantly different at 5% level of significance as indicated by Fisher's protected LSD test.

Yield of Fall 2011 shows that 1.7 kg leafy vegetables can be harvested from about one square meter of land (Table 1). Winter and Spring 2012 shows that about 1 kg of leafy vegetables and sweet peas can be harvested for same square meter of space (Table 2). During both seasons treatments were still not expected to be observed since plots were newly established and all were treated similarly.

In summer of 2012 (Figure 4), both Cherry and Celebrity tomatoes gave an average yield of 10.2 kilograms per square meter while eggplant gave an average of 4.6 kg when planted at plots previously planted with a mixture of clover cover crops (Table 3). However, Okra yield was significantly reduced by 2.8 kg at plots previously planted with clovers. One observation is that tomatoes and eggplant produced a dense canopy while okra did not with the open spaces resulting to the re-growth of clovers under okra plants which most probably competed with the main crop in nutrients resulting in lower yields. In addition the decrease in yield in okra due to covercrops during the establishment phase was probably a result of not having a good weed management.

During fall 2012, lettuce was harvested before winter with an average yield of 700 g per square meter (Table 4). However collard greens lasted until the winter 2012-2013 season and it withstood chilling conditions. Collard greens under CA were 260 g greater per square meter than tilled and no-till with both having 615 g average yield. Summer of 2013 gave an average of 6.6 kg per square meter for pepper while tomatoes under CA resulted in 2.8 kg more yield per square meter than no-till and tilled (6.6 kg). However a year after establishment there was already a seen difference in yield in favor of CA and can also be observed in year 3 (Table 5). With the other vegetables the non-significant effect of CA means that CA did not reduce the yield of vegetables compared to no-till and tilled plots. More research needs to be done but at this point it was observed that the effect of CA can be seen shortly after establishment. Given such success in shorter time is an advantage in promoting CA. Regardless of treatment, converting part of the lawn in urban lands could give about 1 kg per square meter of leafy vegetables and about 6 kg per square meter of fruit-vegetables.

Conclusion

Converting part of the lawn to vegetable production will give about 1 kg and 6 kg per square meter of leafy and fruit vegetables, respectively. Vegetable yields appear to be unaffected by CA and in some species were significantly increased except in okra in competition with weeds. The year 2 and year 3 increase in CA yield shows the potential to see advantages of CA in a shorter amount of time from establishment which may attract potential adopters of CA in urban lands.

Others related studies

Conservation Agriculture / Oasissofa Studies in High School Campuses

Figure 5. Turf lawn converted to Urban Vegetable Conservation Agriculture

Studies on Conservation agriculture or 'Oasissofa' as we call it are being implemented in six high schools as an outdoor laboratory in Greensboro and Durham, North Carolina (Figure 5). Teachers use oasissofa studies for teaching science courses. Students and faculty liked the growing of vegetables in schools which reconnect campus communities to Agriculture: the Science, Technology, Engineering and Math of human survival. Challenges faced are maintenance activities especially during summer time and long holidays when students are having their vacations.

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