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Raising medium function of environmental engineering by using life rubbish to produce carpet turf

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Abstract: Abundant material with low cost was utilized to raise medium function of producing carpet turf by life rubbish. The results showed that the material used could strikingly raise water retentiveness and ventilating of medium. Through the determination of the effect of each growth index of several turfgrass, emergence density, plant height, root growth and individual plant's net primary production were all positively related to the material's amount mixed, showing that the mixture of material could promote turfgrass growth, further proving that the material used raised medium function of producing carpet turf by life rubbish and made most use of life rubbish resources. It provided a scientific base is for application of environmental engineering by using life rubbish to produce carpet turf. So the study had both important theoretic meaning and applied value.
Key words: life rubbish; carpet turf; medium function; environmental engineering

The basic requirement of an ideal city is that life rubbish can be effectively disposed and land greenization can be fully realized (Yanitskiy, 1987; Ma, 1984). On the one hand, as the rapid development of urbanization, urban life rubbish increases day by day, and environmental contamination becomes more serious (Wang, 1997). Rubbish disposal engineering has caused a general attention of the world (Li, 1997a; Li, 1997b; Zheng, 1991; Gao, 1995). But whether from environmental benefit or from economic benefit, the disposed methods generally used such as burying, burning and agricultural use of compost have many problems, they are not perfect (Webber, 1984; Couillard, 1991). In addition, in recent years, some countries transformed rubbish sites to parks or other garden plots (Wang, 1996; Hornick, 1984). This method also has many disadvantages: first, to continuously open up rubbish site contradicts with urban limited land resource; second, because plant roots can only utilize the nutrition of upper rubbish, lower rubbish is unused and wasted, and rubbish resources can not be made most use of. Rubbish was waste material produced by human, to make it return natural ecological system, participate in ecological cycle much accords with ecological law. That is to say, according to ecological principle, considering the prerequisite of environmental, social and economic benefits, how to make most use of rubbish resources so as to compose high-effective and harmonious environment with coordinated development of society, economy and nature, high-effective utilization of matter, energy and information, and ecologically good circulation should be a further research problem by rubbish disposal engineering. On the other hand, as the strengthing of ecological consciousness, to realize land greenization has become common expectation and demand, and lawn has been an important standard for measuring urban environmental quality (Sun, 1989; Hu, 1991; Malcolm, 1987; He, 1999) and a great industry for developed countries. Only in the United States, the yearly income of carpet turf increases at the high speed of 18%, which far exceeds the whole society's speed of economic development of the same period. Compared to this, China is far behind (Duo, 1996; Wang, 1998). At present, among various ways of lawn establishment over the world (Zhang, 1997; Li, 1992; Yu, 1992), the way of scalized and industrialized producing carpet turf which depends on mechanical equipment is generally adopted by developed countries. But what needs to be pointed out is that this carpet turf production is generally chosen at cultivated land and has high-

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quality cultivated soil as medium in a result of wasting land resources and destroying the environment of agricultural ecological system to a certain extent. Consequently, study on environmental engineering of producing carpet turf by life rubbish as medium in place of high-quality cultivated soil has important theoretic meaning and applied value. In carpet turf production, medium function is the key problem of success(Chen, 1991), that is to say, the method should be simple and feasible; medium chosen is abundant and conforms to demand of environmental protection; materials are abundant, with low cost and can strikingly raise medium function. So study on raising medium function of producing carpet turf by life rubbish can provide basis for a new ecological engineering of environment combined by the engineering of rubbish disposal and greenization engineering. There is no reference report on this field yet.

1 Materials and methods

1.1 Life rubbish and its disposal

Life rubbish was taken from rubbish site of Tianjin Dagang District. About 500 kg rubbish was taken back laboratory, first-selected, substances not to decompose or difficult to decompose were removed. Then the rubbish was pulverized, even mixed and put into box specially made by thick plastic plate to compost. The rubbish in the box was sealed hermetically by thin plastic film and there was hot-water insulating layer. After full compost disposal, a little compost rubbish was second-selected, put into oven to stove to constant weight in 50℃ (about 10 h) and reserved of experiment.

1.2 Material and nutritive matter

Sawdust, $NH_4H_2PO_4$ and KH_2PO_4.

1.3 Turfgrass

Lolium perenne L., *Festuca arundinacea L.*, *Agrostis stolofinera L.* and *Poa pratensis L.*

1.4 Compounding medium

The rubbish stoved above was respectively weighted 30, 29, 28, 27, 26, 25 and 24g seven levels. They were separately mixed dry sawdust 0, 1, 2, 3, 4, 5 and 6g to form seven medium treatment levels which were: rubbish 30g + sawdust 0g(represented by $R_{30}S_0$ in the following), rubbish 29g + sawdust 1g($R_{29}S_1$), rubbish 28g + sawdust 2g($R_{28}S_2$) and the like. In the end, $NH_4H_2PO_4$ 1.5g and KH_2PO_4 1.5g were respectively added to the seven medium treatments.

1.5 Turfgrass culture

Seven medium treatment levels were respectively put into culture dishes with diameter 10 cm and even mixed, then each kind of turfgrass seed 100 grains were even sowed in the medium respectively. The experiment was repeated 3 times. Finally these treatment levels were watered to wet but not watery and kept to the end of the experiment.

1.6 Culture conditions

The experiment was conducted on the plant culture table in the laboratory with temperature 20—30℃ and relative humidity 50%—65%. The light was natural light through the laboratory and did not add illumination. The daily illumination was 1500—2600 lx.

1.7 Determined contents

Emergence dynamics: the emergence date of each turfgrass was recorded. To the 9th day of the experiment, density was determined once every 5 days. To the 39th day, the determination was 7 times all together so as to understand emergence dynamics of each medium and varied law.

Plant height dynamics: From the 9th day to 39th day, plant height was determined 7 times which was conducted at the same pace with the determination of emergence dynamics. The method was that 3 random plants in each culture dish were marked with black thread and their average height was assumed as the plant height of the dish.

The situation of root growth: To the 39th day, among the plants marked in each dish, the plants with middle growing-potential were chosen and taken out with medium around, on principle of decreasing to harm plants around. The plants taken out together with medium were put into big beaker with 1000 ml clean water to cleanse medium in order to determine fibrous root number and the length of the longest fibrous root of each plant.

Individual plant′s net primary production: After the roots of the plants above were determined, the plants were absorbed water by filter-paper and then wrapped by toiled paper, naturally dried in the shade to constant weight so as to weight their weight.

pH value and green degree: The pH value of medium was determined twice respectively at the sowing day and the 39th day with pH test paper. The turfgrass′ green degree of each medium was determined on the 39th day, and the method was that turfgrass was put on white paper(serve as a foil) to be contrasted.

Feedback effect of medium under water stress: To the 39th day, after the determined indexes above were fulfilled, all culture dishes were watered with 15 ml water, then would not be watered to observe feedback effect of turfgrass growth under water stress so as to define water retentiveness of medium.

2 Results

2.1 Emergence dynamics

2.1.1 Initial emergence

L. perenne in each medium all emerged on the 4th day after sowing, to the 9th day, the emergence was from more to less with the order: $R_{24}S_6 > R_{25}S_5 > R_{26}S_4 > R_{27}S_3 > R_{28}S_2 > R_{29}S_1 = R_{30}S_0$; and their emergence density was 41.00, 37.33, 35.00, 34.67, 16.33, 7.00 and 7.00 plant/utensil respectively. It could be seen that when the amount of sawdust reached 3g, emergence of *L. perenne* increased strinkingly. Then if the amount of material was still increased, though initial emergence increased, the range was not large. *F. arundinacea* all emerged on the 5th day after sowing, its emergence order from more to less was the same as *L. perenne*, according to medium order, their density was 39.00, 36.00, 34.00, 33.33, 31.67, 29.67 and 3.67 plants/utensil respectively, showing that the lowest amount of material(1g) could make initial emergence of *F. arundinacea* strongly raise. Then continuously to increase the amount of material could increase emergence slightly but the range became relatively low. *P. pratensis* in media except $R_{30}S_0$ all emerged on the 7th day, to the 9th day, the emergence order from more to less was similar with *L. perenne*, that was: $R_{24}S_6 > R_{25}S_5 > R_{26}S_4 = R_{27}S_3 > R_{28}S_2 > R_{29}S_1 > R_{30}S_0$, their density was 18.67, 18.00, 6.33, 5.00, 1.33 and 0 plant/utensil, showing that only the amount of material increased to 5 g could greatly increase initial emergence of *P. pratensis*. Except $R_{30}S_0$ and $R_{29}S_1$, *A. stolonifera* in other media all emerged on the 7th day, with similar emergence order from more to less with *L. perenne*, and their emergence density was 17.33, 12.00, 8.33, 3.33, 2.67, 0 and 0 plants/utensil respectively, showing that when sawdust increased to 5g, initial emergence could be raised greatly.

2.1.2 The highest emergence

From the highest emergence observed(Table 1), variance analysis on the highest emergence density of four kinds of turfgrass in each medium showed striking difference($P < 0.01$). The highest emergence density of four kinds of turfgrass were all with the order: $R_{24}S_6 > R_{25}S_5 > R_{26}S_4 > R_{27}S_3 > R_{28}S_2 > R_{29}S_1 > R_{30}S_0$, but four kinds of turfgrass were with different time of the highest emergence. From the results determined, the highest emergence of *L. perenne* in $R_{30}S_0$, $R_{29}S_1$ and $R_{28}S_2$ appeared on the 19th day after sowing, in other four media appeared on the 24th day, illustrating that as the increase of material′s amount, seed germination could be raised and the date of the highest emergence was postponed. As to *P. pratensis*, in $R_{30}S_0$ the highest emergence appeared on the 19th day, in $R_{29}S_1$ and $R_{28}S_2$ appeared on the 14th day, in other four media appeared on the 24th day, showing that as the increase of material's amount, the highest emergence increased but the date of the highest emergence was postponed, and a little material could make the highest emergence appear in advance. For *F. arundinacea*, the highest emergence all appeared on the 34th day, indicating that though the material could raise emergence, it did not affect the date of the highest emergence. The highest emergence of *A. stolonifera* in medium $R_{30}S_0$ appeared on the 14th day, in $R_{29}S_1$ appeared on the 19th day, and in other four media appeared on the 24th day, showing that as the increase of the material's amount the emergence increased, but the date of the highest emergence was postponed.

Table 1 The highest emergence of turfgrass(plants/utensil)

Turfgrass	Medium						
	$R_{30}S_0$	$R_{29}S_1$	$R_{28}S_2$	$R_{27}S_3$	$R_{26}S_4$	$R_{25}S_5$	$R_{24}S_6$
L. perenne	31.67^{d}	33.33^{d}	46.33^{c}	49.33^{bc}	55.00^{ab}	56.67^{ab}	62.67^{a}
P. pratensis	9.00^{f}	22.67^{e}	32.00^{de}	34.00^{cd}	41.33^{bc}	48.67^{ab}	54.33^{a}
F. arundinacea	38.00^{d}	68.00^{c}	72.33^{bc}	73.33^{abc}	74.00^{abc}	78.00^{ab}	82.00^{a}
A. stolonifera	7.33^{d}	10.00^{d}	25.67^{c}	34.67^{b}	37.33^{b}	37.67^{b}	49.67^{a}

Notes: the symbols a, b, c... represent test level($P<0.01$).

2.1.3 Conserved emergence

To the 39th day, the conserved emergence rate (which equals the percentage of emergence density determined to the highest emergence density) of four kinds of turfgrass in each medium was different (Table 2). From different grass species, the total conserved emergence was with the trend: *F. arundinacea* > *L. perenne* > *P. pratensis* > *A. stolonifera*. For *L. perenne*, when the material's amount reached 3g, conserved emergence rate of 99.33% was obtained, and as increase of the material's amount, conserved emergence rate declined but not very clearly. Compared with *L. perenne*, conserved emergence rate of *P. pratensis* was relatively low, reaching the highest when the material's amount was 2g, then declined slightly. Conserved emergence rate of *A. stolonifera* in $R_{30}S_0$ and $R_{29}S_1$ were all zero, and from $R_{28}S_2$ it began to increase gradually. To sum up, the effect order of the material on conserved emergence rate of each turfgrass was: *L. perenne* > *A. stolonifera* > *P. pratensis* > *F. arundinacea* which could be testified by the coefficients of correlation of each turfgrass' conserved emergence density and medium, that was successively $0.9812^{**} > 0.9711^{**} > 0.9706^{**} > 0.8104^{*}$.

Table 2 Actual conserved emergence rate on the 39th day of sowing(%)

Turfgrass	Medium						
	$R_{30}S_0$	$R_{29}S_1$	$R_{28}S_2$	$R_{27}S_3$	$R_{26}S_4$	$R_{25}S_5$	$R_{24}S_6$
L. perenne	83.14	86.02	86.34	99.33	98.91	98.24	97.86
P. pratensis	40.78	47.07	81.25	80.38	78.05	72.59	72.83
F. arundinacea	92.97	95.56	100.00	99.55	100.00	98.29	97.56
A. stolonifera	0	0	55.75	62.33	75.01	78.76	81.88

2.2 Plant height growth

From the determination of plant height growth dynamics, turfgrass in different medium grew fast at early stage of culture, but grew slowly at late stage because of medium nutrition's limitation. To the 39th day (Table 3), in different medium, plant height of each turfgrass reached extremely striking difference ($P<0.01$), and with the same order: $R_{24}S_6 > R_{25}S_5 > R_{26}S_4 > R_{27}S_3 > R_{28}S_2 > R_{29}S_1 > R_{30}S_0$. This showed that the material had obvious positive effect on plant height growth, *L. perenne*, *P. pratensis*, *F. arundinacea* and *A. stolonifera* had extremely striking positive correlation with the material's amount and their coefficients were 0.9606^{**}, 0.9848^{**}, 0.8972** and 0.9888** respectively. The material increased plant height of each turfgrass with the order: *A. stolonifera* > *P. pratensis* > *L. perenne* > *F. arundinacea*. When the material's amount increased to 6g, plant heights of *A. stolonifera*, *P. pratensis*, *L. perenne* and *F. arundinacea* were 546.67%, 286.53%, 221.94% and 218.87% to plant height in $R_{30}S_0$. When the material's amount was more than 3g, plant heights of four turfgrass were all 100% larger than plant height in $R_{30}S_0$. This showed that the material could greatly raise medium function and increase plant height growth.

Table 3 Plant height of turfgrass on the 39th day(cm)

Turfgrass	Medium						
	$R_{30}S_0$	$R_{29}S_1$	$R_{28}S_2$	$R_{27}S_3$	$R_{26}S_4$	$R_{25}S_5$	$R_{24}S_6$
L. perenne	8.34^c	8.96^c	13.52^b	14.21^b	17.78^a	18.00^a	18.51^a
P. pratensis	2.97^e	4.11^{de}	5.67^{cd}	6.44^{bc}	7.33^{ab}	8.34^a	8.51^a
F. arundinacea	9.06^d	12.56^c	17.27^b	18.51^{ab}	18.78^{ab}	19.09^{ab}	19.83^a
A. stolonifera	—	—	4.04^c	4.70^{bc}	5.89^b	6.33^b	8.20^a

Note: test level($P<0.01$)

2.3 The situation of seedling root growth

Table 4 shows the situation of seedling root growth of each turfgrass in each medium. Whether fibrous root number or root length, four turfgrass were all with the four from good to bad: $R_{24}S_6 > R_{25}S_5 > R_{26}S_4 > R_{27}S_3 > R_{28}S_2 > R_{29}S_1 > R_{30}S_0$, and root length had extremely striking positive correlation with the material's amount, the coefficients of *L. perenne*, *P. pratensis*, *F. arundinacea* and *A. stolonifera* were 0.9958**, 0.9612**, 0.9052** and 0.9820**, respectively. This indicated that the material had obvious positive effect on root growth of each turfgrass. From fibrous root number, because of the use of the material, the most fibrous root number of *L. perenne*, *P. pratensis* and *F. arundinacea* were respectively 2.08, 2.33 and 1.91 times fibrous root number in $R_{30}S_0$, and that of *A. stolonifera* was at least 2 times from the trend. From root length, root lengths of *L. perenne*, *P. pratensis and F. arundinacea* were 3.58, 5.24 and 3.94 times root length in $R_{30}S_0$, and that of *A. stolonifera* was at least 2—3 times from the trend.

Table 4 The situation of seedling growth of turfgrass(numbers/plant, cm)

Medium	*L. peranne*		*P. pratensis*		*F. arundinacea*		*A. stolonifera*	
	Fibrous root	Root length	Fibrous root	Root length	Fibrous root	Root length	Fibrous root	Root length
$R_{30}S_0$	4.0	1.53	3.0	0.33	3.3	1.07	—	—
$R_{29}S_1$	4.0	2.03	3.3	0.43	3.3	2.63	—	—
$R_{28}S_2$	4.0	3.00	4.0	0.50	4.3	3.33	2.3	0.90
$R_{27}S_3$	6.0	3.67	4.7	0.67	4.7	3.33	2.7	1.17
$R_{26}S_4$	7.0	4.32	5.0	1.33	6.0	4.17	3.7	1.50
$R_{25}S_5$	7.0	4.72	6.3	1.50	6.0	4.18	5.0	2.07
$R_{24}S_6$	8.3	5.47	7.0	1.73	6.3	4.21	5.7	2.67

2.4 Individual plant's net primary production

Individual plant's net primary production (PNP) is an index for measuring plant's photosynthetic efficiency of each turfgrass in different medium. It can be calculated according to the formula: PNP = AGP + UGP − PR. In the formula, PNP is individual plant's net primary production; AGP is aboveground gross primary production; UGP is underground gross primary production; PR is the energy consumed by respiration. Table 5 shows PNP of each turfgrass in different medium. It could be seen that as the increase of the material's amount, PNP of each turfgrass increased to different extent, and the photosynthesis efficiency of each turfgrass in each medium was $R_{24}S_6 > R_{25}S_5 > R_{26}S_4 > R_{27}S_3 > R_{28}S_2 > R_{29}S_1 > R_{30}S_0$. When the material's amount increased to 6g, PNP of *L. perenne*, *P. pratensis* and *F. aruninacea* respectively increased 2.48, 5.65 and 2.67 times, and PNP of *A. stolonifera* at least increased 2 times from the trend. Further analysis showed that the increase of turfgrass PNP was as extremely striking positive correlation with the increase of the material's amount, the coefficients of *L. perenne*, *P. pratensis*, *F. arundinacea* and *A. stolonifera* were 0.9859**, 0.9801**, 0.9410** and 0.9193**, respectively.

Table 5 Individual plant's net primary production(mg/plant.day)

Turfgrass	Medium						
	$R_{30}S_0$	$R_{29}S_1$	$R_{28}S_2$	$R_{27}S_3$	$R_{26}S_4$	$R_{25}S_5$	$R_{24}S_6$
L. perenne	0.0771	0.0771	0.1143	0.1343	0.1629	0.1800	0.1914
P. pratensis	0.0094	0.0188	0.0188	0.0313	0.0406	0.0531	0.0531
F. arundinacea	0.0882	0.1382	0.1471	0.1471	0.1559	0.1971	0.2353
A. stolonifera	—	—	0.0156	0.0219	0.0281	0.0281	0.0313

2.5 Green degree and pH value

Comparative study on green degree of each turfgrass in each medium indicated that as the material's amount increased, among turfgrass with the same grass species in each medium, only green degree in $R_{30}S_0$ and $R_{29}S_1$ was slightly good, and in other media had no obvious difference. This showed that the mixture of material could maintain turfgrass green degree well. From the pH value of each medium, on the sowing day, they were all between 6.9—7.0, to the 39th day, they increased slightly which were 7.1—7.2, showing that the material could also maintain pH value of the medium well.

2.6 Medium effect under water stress

Under water stress, the observation of each medium's water retentiveness indicated that the 3rd day of stopping water, $R_{29}S_1$ and $R_{30}S_0$ were basically dry; $R_{28}S_2$, $R_{27}S_3$ and $R_{26}S_4$ were dry on the surface and wet in internal; $R_{25}S_5$ and $R_{24}S_6$ were wet on the surface and wetter in internal. As to plant growth, to the 3rd day of stopping water, most plants of *L. perenne* in $R_{29}S_1$ and $R_{30}S_0$ were wilting; in $R_{28}S_2$, $R_{27}S_3$ and $R_{26}S_4$ a little wilting; but in $R_{25}S_5$ and $R_{24}S_6$ there was no wilting. From wilting trend, *F. arundinacea*, *P. pratensis* and *A. stolonifera* were similar with *L. perenne*. The wilting-resistant ability of four turfgrass was from strong to weak: *F. arundinacea* > *L. perenne* > *P. pratensis* > *A. stolonifera*. To the 5th day of stopping water, $R_{28}S_2$, $R_{27}S_3$ and $R_{26}S_4$ all became day, and most plants in them were wilting; $R_{25}S_5$ and $R_{24}S_6$ were wet only in internal, all dry on the surface, and a little plants in them were wilting; the difference between grass species still conformed to the law above. To the 7th day of stopping water, $R_{25}S_5$ and $R_{24}S_6$ all became dry, plants in them were all wilting. To sum up, water retentiveness of each medium was from good to bad with the order: $R_{24}S_6 > R_{25}S_5 > R_{26}S_4 > R_{27}S_3 > R_{28}S_2 > R_{29}S_1 > R_{30}S_0$, indicating that the material could effectively raise water retentiveness of the medium.

3 Discussion and conclusion

At present carpet turf production most uses high-quality soil as medium over the world. According to the difference of making way and use of turf, to product carpet turf needs soil medium of 5—10 cm depth(Zhang, 1997). So from ecological environmental benefit, it can be seen that the establishment way of this carpet turf will improve urban ecological environment in the meantime destroy agricultural ecological environment in outskirts(Hu, 1991). If to produce carpet turf according to above way, after three times production, the soil can not be used to produce crops. Thus the medium (high-quality cultivated soil) needed by exchange of matter and energy in agricultural ecological system would be moved to the city. This contradicts with the demand of human in material production of ecological system(Ma, 1984). In addition, from environmental economic benefit, because high-quality soil often has many propagula of weeds, using the soil as medium to product carpet turf usually has serious invasion of weeds(Chen, 1991) which not only increase management cost, lowers benefit, but also greatly lowers ornamental function of lawn due to serious weeds. Now in China, life rubbish disposal most opens up burying-site to bury(Li, 1997; Zheng, 1991). But this disposal way can only disposel about 30% of urban life rubbish, about 70% is in unused state and piles up. So except that rubbish resources can not be made use of, the environment is contaminated(Duo, 1999). That is to say, poisonous gases from rubbish and sinking caused environmental problems. There were also reports on planting plants on rubbish site(Wang, 1996). Because plant roots can only absorb nutrient of upper rubbish, nutrient of lower rubbish is in unused state, this utilization of rubbish resources can not realize the purpose of making most use of rubbish resources. So this way of rubbish resources utilization is not perfect (Wang, 1997). In view of this idea, the way of using life rubbish as the medium of carpet turf production to establish lawn has great superiority. At first from ecological environmental benefit, it can make most use of life rubbish resources in the meantime avoid poisonous matter into food chain and reduce wasting land resources. Thus urban environment is improved, at the same time agricultural ecological environment is protected. Secondly, from economic benefit, because compost life rubbish has little proragula of weeds, the turf cultured by it is managed easily and with high ornamental value. So production cost is lowered greatly and economic benefit increases. Though medium function of carpet turf is a very important factor of carpet turf production(Chen, 1991), there was no reference report on having compost life rubbish as the medium of carpet turf.

Compost life rubbish contains much nutrient needed by turfgrass growth, but its structural characteristics and release way are greatly different with soil medium. So study on raising medium function of life rubbish has become the key problem of environmental engineering application by using life rubbish to produce carpet turf. In view of this, compost life rubbish was used as medium of carpet turf and abundant sawdust with cost was chosen as material so as to study raising medium function of producing carpet turf compost life rubbish. By mixing different amount of the material into rubbish medium and adopting four turfgrass cultivated widely in China, the experiment studied the mixed medium's effect on turfgrass growth and each index of medium function. The results showed that because of mixture of the material, medium function can be improved obviously, especially water retentiveness of medium, which was possibly related closely to the material's obstructing water losing path of medium and its strong adsorption of water. In addition, owing to the material's mixture, the united effect of material and medium could make the mixed medium show good coordinated effect, improving medium function, especially making medium loose, improving ventilating ability of the medium. From the mixed medium's effect on turfgrass growth, as the increase of material's amount, emergence dynamics, plant height growth dynamics, root growth dynamics and individual plants's net primary production of turfgrass had obvious positive effect, and most indexes were as extremely striking positive correlation with the increase of the material's amount. Though the positive effect was slightly different for different turfgrass, the total trend was: $R_{24}S_6 > R_{25}S_5 > R_{26}S_4 > R_{27}S_3 > R_{28}S_2 > R_{29}S_1 > R_{30}S_0$. From the material increasing turfgrass growth, when the material was 6.7%— 10.0% of the mixed medium, turfgrass growth increased very clearly, generally increasing amount 200% for each turfgrass. When the amount of material added was larger than 10% of the mixed medium, though turfgrass growth could be promoted, the range dropped, only water retentiveness of the medium was improved greatly. So in the carpet turf production of having life rubbish as medium, compost life rubbish mixed 6.0%—13.0% the material can strinkingly improve medium function, greatly raise turfgrass growth so as to shorten turf culture time, lower productive consumption (such as by means if saving water, decreasing man-hour) and lower productive cost. Moreover, because the material had light weight and good cohesiveness, productive characteristics of the turf cultured by the medium can be greatly raised. In productive action, mankind creats value in the meantime produces losts of all kinds of waste material such as life rubbish. The waste material is often obstructed out ecological system, can not participate in ecological cycle once again and can not play its regenerative value. This is not the management format of matter cycle in natural ecological system according to ecological principle(Ma, 1984). From this meaning, the purpose of the study is to compose utilization system of life rubbish resources, to make most use of life rubbish resources with participation of turfgrass which has the function of greenizing environment, and to bring about high-efficient, harmonious economic benefit and environmental benefit. Therefore, it is not difficult to know that the ecological engineering of environment of having life rubbish as medium to produce carpet turf has important theoretic meaning and very wide prospect, developing new industry of environmental protection.

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