2002 STEEP III FINAL REPORT

RESEARCH PROJECT TITLE: Managing the Economic Transition to No-Till Farming in the Pacific Northwest

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PROJECT OBJECTIVES:

1. To identify appropriate economic strategies for PNW farmers in different business and agro-climatic situations to successfully manage financial risk and to maintain acceptable economic returns during the transition to no-till farming.
2. To disseminate the results on efficient strategies for managing no-till adoption risk to growers, policy makers and others through extension bulletins, other publications, talks at field days and other meetings, and through other media.

KEY WORDS: No-till, transition, risk, economics

STATEMENT OF PROBLEM: The Pacific Northwest (PNW) lags the rest of the country in adoption of no-till. The financial risks of large up-front costs for purchasing no-till drills have been a barrier to adoption of no-till for many. These barriers have been magnified by low crop prices and by depressed markets for used conventional farm machinery. Recent economic case studies of PNW no-till farmers by the investigators showed wide variation in their economic success depending on how the financial transition to no-till was managed. The timing of machinery purchases, purchase of new or used machinery, custom hiring of some operations, renting or leasing machinery, and management of repair and retooling costs must be strategically tailored to the farm situation. A better understanding of the nature of the risks and returns for different no-till transition strategies could lead to policies and educational programs which would accelerate adoption of no-till where it is suitable.

ZONE OF INTEREST: PNW dryland agro-climatic zones with 8" to 22" av. ppt/yr.

ABSTRACT OF RESEARCH FINDINGS: Analysis of 266 surveyed east-central Washington farmers showed that 20% had tried no-till. Most had used this practice with continuous spring cropping. The survey revealed that an NRCS-Extension soil conservation educational program had boosted the adoption of no-till.

A sample of 11 successful long term PNW no-till growers used a variety of no-till transition strategies. Some rented larger tractors needed only for drilling and some retrofitted no-till drills in farm shops. Others shared no-till drills and tractors with neighbors, timed purchases of drills and tractors during high cash flow years, and shopped for low cost financing.

Some farmers did custom no-till to help pay for drills. Most retained their conventional equipment as a safety hedge.

We subsequently interviewed 10 no-till farmers from eastern WA who considered themselves *in the transition* from conventional farming. Although the speed of conversion to no-till varied greatly, none of the farmers "backtracked" in no-till acreage over five years. Most transition farmers custom hired or rented a drill in years 1-3, but over half had purchased a drill by years 4 and 5. All but one of the drill purchasers reported having paid cash for their no-till drills.

Recommendations from using a farm management risk program revealed that gradual adoption of no-till, graduating up to 30% of acreage in six years, was least risky if no-till began with a 10% yield penalty. Large farmers with the cash or financing should purchase a no-till drill early on. Custom and rental drill acquisition in early years of the transition is recommended for small farmers, especially for gradual no-till acreage expansion.

Low equity farmers should be careful about adopting no-till if they fear an initial yield penalty. Small low equity farmers may wish to wait until they can pay cash for a lower cost no-till drill.

RESULTS AND INTERPRETATION:

Objective 1. To identify economic strategies for PNW farmers to successfully manage financial risk during the transition to no-till farming. During this project we have (1) examined survey results from 266 east-central Washington farmers to examine which ancillary conservation practices farmers use during the transition to no-till, (2) examined the practices used by 11 experienced no-till farmers for reducing machinery costs during their successful no-till transition, (3) analyzed the pattern over time of the no-till transition process for 10 eastern Washington farmers, and (4) used a farm risk management program to compute the risk of investment failure for several no-till transition strategies for farms of different sizes and equity position.

A survey of 266 east-central Washington farmers showed that farmers making the transition to no-till often adopt other conservation practices simultaneously. For example, 20.4 percent (8.3+9.8+1.5+0.8 percent from Figure 1) of the sampled farmers had used no-till to some extent, but most had used it jointly with one or two other erosion control practices. Some 11.3 percent had used no-till jointly with spring cropping (Figure 1), possibly to take advantage of moisture conservation advantages of no-till. Similar results were found in our conservation farming literature survey which indicated intensification of cropping permitted by no-till and min-till was a major factor in a 44 percent reduction in fallow in North America over the last three decades. The survey of 266 eastern Washington farmers also showed that participation in an NRCS-Extension educational program significantly boosted the adoption of no-till among farmers. The educational program provided research results on effective no-till technologies and highlighted the off-site costs of wind erosion.

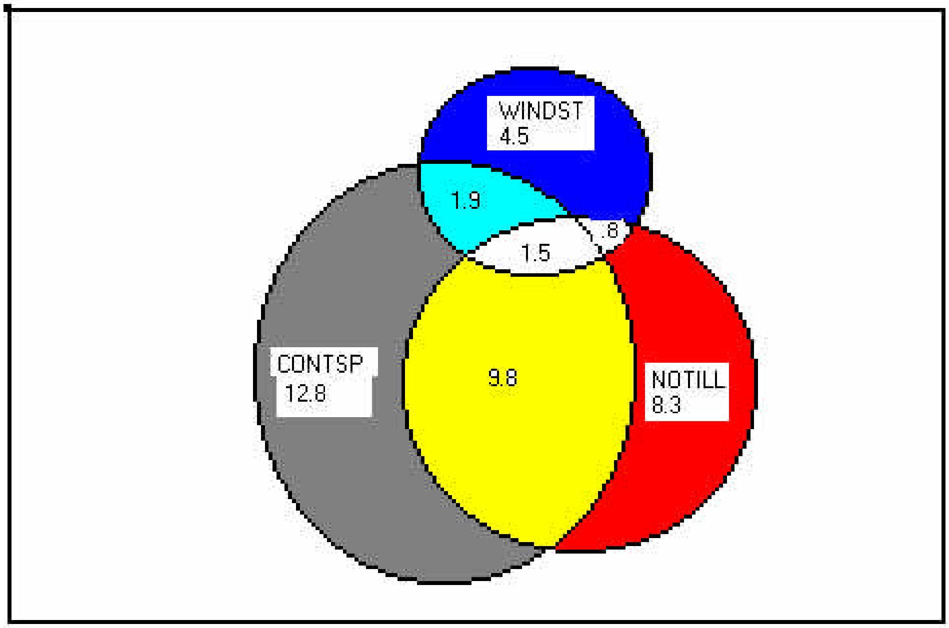

Fig. 1. Percentage of respondents by adoption group.

Eleven long term PNW no-till farmers were surveyed to learn from their experience. This group was beyond the transition and was no-tilling all or most of their farms. Several of these farmers had purchased no-till drills and we compared their cost of drill ownership to prevailing custom rates. Based on their annual acres no-till seeded each year, the comparison showed that most were minimizing seeding costs by owning their drills. They used a wide variety of strategies to economize drill ownership and use costs. Some farmers rented larger tractors needed only for no-till drilling, some bought used drills and retrofitted them, some assembled no-till drills in farm shops. Others shared no-till drills and tractors with relatives or neighbors, timed purchases of drills and tractors during high cash flow years, and shopped for low cost financing for drill and tractor purchases. Some did custom no-till planting to help pay for drills. These results indicate that success in the no-till transition process requires adapting a strategy that suits the particular business and agro-climatic situation of the farm.

We conducted comprehensive personal interviews with 10 no-till wheat and barley growers from Whitman and Adams counties, WA who considered themselves still in the transition process from conventional farming, but who had accumulated about five years no-till experience. Each farmer provided information on the farm's size, financial position, and crop rotations at the initiation of the transition. The farmer also described annual no-till drill acquisition (custom, rent, lease, or purchase), annual no-till acreage expansion, and yield experience during the transition period (Tables 1-3).

Table 1. The average, lowest and highest response to selected questions by 10 transition no-till farmers in eastern Washington, spring 2001

Question	Low	Mean	High
Year began using no-till	1991	1994	1997
Farm acres currently in no-till	240	1,398	2,500
Percent of farm currently in no-till	7	38	100
At year 1 of Transition, % of land rented	0	46	100
At year 1 of Transition, % of land paid off	5	44	100
At year 1 of Transition, % of land making payments on	0	49	100
If land was purchased during year 1…annual payment ($)	11,200	16,233	25,000
If land was purchased during year 1…Interest rate (%)	7	8	9
If land was purchased during year 1…years to pay off	10	16	32
Percentage crop share to landlord on leased property	30	32	33
Percentage of fertilizer bill paid by landlord	20	26	33

The ten farmers whose responses are summarized in Table 1 show great disparity in land tenure at year 1 of their no-till transition. The group includes farmers who rented all their land, who owned all their land but were still paying for it, and who owned all their land and had fully paid for it. This suggests that the no-till transition may not require one particular land tenure situation.

These survey results also suggest that eastern Washington farmers make the transition to no-till gradually. Although the speed of conversion to no-till varied greatly among the six farmers listed in Table 2, it is interesting that none of the six "backtracked" in no-till acreage over the five years. Each year the same or an increasing percent of acreage was no-tilled. The results in Table 3 indicate that most farmers began by custom hiring or renting a drill in years 1-3 of the transition. But over half of this group of eastern Washington growers had purchased a drill by years 4 and 5. All but one of the drill purchasers in this group reported having paid cash for their no-till drills which ranged in cost from $13,618 to $65,000. These results indicate that no-till farmers consider drill ownership a desirable goal for economic and agronomic reasons. However, most desire to reduce the investment risk by deferring no-till drill purchase until they can pay cash. The types of drills purchased included: McGregor, Yielder, Great Plains, Cross Slot, Palouse Zero Till, and Flexicoil Air Seeder. This diversity of equipment suggests that growers are buying models considered appropriate for their particular soils, topography and climatic conditions. The surveyed growers usually kept their conventional tillage equipment. This equipment was viewed as having a low sale value. It also provided a cheap "insurance" if it were necessary to revert to conventional tillage on some fields.

Table 2. Pattern of no-till expansion during transition years for six farmers in eastern Washington.[a]

Farmer	Year	Crop(s)	Previous Crop	No-Till Acres	% of Farm in No-Till
A	Year 1	WW, SW	SW	250	10
	Year 2	WW, SW	SW	250	10
	Year 3	WW, SW, Seed Peas	WW, SW	385	15
	Year 4	WW, SW, Peas	WW, SW, Peas	450	18
	Year 5	WW, SB, WS, Peas	WW, SW, Peas	1050	42
	Note: Farmer A completed the transition to 100% no-till in year 6.				
B	Year 1	SW, Peas	WW	400	5
	Year 2	SW, Peas	WW	800	11
	Year 3	SW, SB, Peas	WW	1600	21
	Year 4	SW, SB, WW	Peas	1600	21
	Year 5	SW, SB, Peas	WW	1600	21
C	Year 1	SB	SW	160	5
	Year 2	DNS	SB	160	5
	Year 3	SB	DNS	160	5
	Year 4	SB, DNS	SB	320	9
	Year 5	SB, Yellow Mustard	SB, DNS	492	14
D	Year 1	WW	SB	70	2
	Year 2	WW	SB	90	2
	Year 3	WW	Chem Fallow	245	5
	Year 4	WW	Barley	300	6
	Year 5	WW	Lentils	610	12
E	Year 1	SB, Lentils, WW	WW, SB, Lentils	1800	71
	Year 2	SB, Lentils, WW	WW, SB, Lentils	2400	94
	Year 3	SB, Lentils, WW	WW, SB, Lentils	2400	94
	Year 4	SB, Lentils, WW	WW, SB, Lentils	2400	94
	Year 5	SB, Lentils, WW	WW, SB, Lentils	2500	98
F	Year 1	SB	WW	80	4
	Year 2	SB, SW, Mustard	WW, SB, WW	365	16
	Year 3	SW, Mustard, SB	SB, WW, WW	585	26
	Year 4	SW,Must,Safflow.,SB,Oats	SB, WW, WW,	845	38
	Year 5	Safflower, SB, SW	WW, Mustard, SB	2250	100

[a] Sample includes farmers providing complete information to these questions.

Table 3: Percent of nine farmers acquiring no-till drills by different means during the 5-year transition period

Year	Custom	Rent	Purchase
1	33	44	22
2	22	56	22
3	0	67	33
4	11	33	56
5	11	22	67

The "transition no-tillers" were ask to reply to the general question: "Would you have done anything different to maintain a secure cash flow after switching to no-till?" These responses appear to confirm that economic risk is a potential barrier to no-till adoption.

a. "The biggest problem with no-tillers is that there is always the fear of the unknown. Most guys personally know four or five farmers that went bankrupt trying to make it work. This is quite discouraging, and you feel like you are alone in a new frontier."
b. "I do wish that the cost of those drills would come down a bit."
c. "You need to find an inexpensive drill to get started and try not to [rely on] custom hire. It is sad when you see others go bankrupt, but you just got to keep on trying."
d. "I'd try to find a less expensive high horsepower tractor, and I'd sell all my conventional tillage equipment. It's tough to try to find the right drill that will work for you, and to absorb the cost. Since we don't like to burn, we want a drill that is big enough to finish seeding on schedule, and can punch through all of the extra residue."

We used the Simetar farm management risk simulation program developed at Texas A&M University to assess the riskiness of different no-till transition strategies. The program was applied to eastern Palouse wheat-barley-pea farms of different sizes and equity structures. The farm's annual net after tax cash flow was simulated for 500 "draws" from risky weather and prices for each of the years of a six-year transition to no-till farming. We used historic crop price patterns to project future price fluctuations for wheat, barley and peas. Trends in average crop prices over the transition period were based on national forecasts. Yield risk with conventional and no-till wheat, barley, and peas was based on annual yield fluctuations of these crops in eastern Palouse field experiments. To reflect the "learning curve," no-till yields were assumed to suffer a 10% penalty relative to conventional tillage in year 1 which gradually disappeared by year 6. The farm received government payments, as eligible, from the loan program, direct payments, and counter cyclical payments of the 2002 Farm Bill. Cash outflows included cash crop production expenses, debt repayments for machinery and other assets, property and income taxes, insurance, overhead, and family living withdrawals of $17,118 to $32,073 per year depending on farm size and equity. Owned land--20% or 80% of farmed land depending on equity position–was assumed paid for. Production costs were assumed to inflate at 3%/yr. Landlord share rents were 1/3 and 1/4 for grains and peas, respectively, with corresponding landlord contributions for crop insurance and fertilizer. Rental and custom hire rates for no-till drills were set at $12 and $20 per acre, respectively. The purchase price for a new no-till drill was $53,750 with 30% down and the balance amortized over the next five years at 8% interest.

The risk modeling exercise yielded 500 x 6 years or 3000 annual cash flow computations for each of 39 no-till transition strategies. This generated a total of 117,000 annual economic farm cash flow performances. Using the 500 runs for each six-year no-till transition strategy, we calculated the probability of "transition failure" (n failures/500) for two different measures of failure. Table 4 presents results for "transition failure" defined as experiencing two consecutive years of negative cash flow. This means the farmer is unable to meet production expenses, debt payments, and family living from current year's crop revenues plus government payments for two years in a row. In agriculture, variable incomes are expected so most growers were not considered likely to "give up on no-till" after just one year's cash flow shortfall. However, we surmised that some growers would become disenchanted after two consecutive years of negative cash flow. In contrast, Table 5 defines "transition failure" as a negative cumulative cash flow balance at the end of the six-year transition period. This criterion represents farmers who are willing to "grit it out" for the full six years and consider the transition a failure only if all the positive cash balance years fail to out balance the negative years and year 6 ends with a cumulative cash flow deficit.

Table 4. Simulated probability of no-till transition failure due to two consecutive years of negative cash flow during the six year transition period for a WW-SB-pea rotation in the eastern Palouse

	Immediate adoption				Moderate adoption				Gradual adoption			
Drill Acq. Sequence	LF80	LF20	SF80	SF20	LF80	LF20	SF80	SF20	LF80	LF20	SF80	SF20
P-6	0.18	0.57	0.48	0.89	0.15	0.53	0.42	0.87	0.10	0.44	0.35	0.76
R-1	0.19	0.59	0.53	0.91	0.15	0.54	0.45	0.89	0.10	0.44	0.38	0.76
R-2	0.21	0.63	0.51	0.91	0.15	0.55	0.44	0.89	0.11	0.42	0.32	0.77
R-3	0.23	0.66	0.50	0.91	0.16	0.55	0.39	0.85	0.10	0.42	0.31	0.74
R-4	0.24	0.69	0.49	0.89	0.16	0.58	0.39	0.84	0.10	0.42	0.29	0.74
R-5	0.26	0.70	0.46	0.88	0.17	0.60	0.33	0.78	0.09	0.41	0.23	0.63
R-6	0.26	0.71	0.44	0.86	0.18	0.60	0.30	0.76	0.09	0.40	0.19	0.58
C-1	0.20	0.60	0.54	0.92	0.15	0.54	0.45	0.89	0.10	0.45	0.38	0.76
C-2	0.24	0.67	0.54	0.92	0.16	0.56	0.44	0.89	0.11	0.42	0.32	0.77
C-3	0.28	0.71	0.54	0.93	0.17	0.58	0.41	0.86	0.10	0.42	0.32	0.74
C-4	0.30	0.76	0.54	0.92	0.18	0.62	0.41	0.86	0.10	0.43	0.29	0.74
C-5	0.32	0.78	0.52	0.91	0.19	0.64	0.36	0.82	0.09	0.42	0.24	0.64
C-6	0.33	0.79	0.51	0.90	0.20	0.65	0.33	0.80	0.09	0.41	0.20	0.59

Note: Gradual adoption involves no-tilling 5%,10%,15%,20%,25%,30% of total acreage in years 1 through 6; Moderate adoption involves no-tilling 40%,50%,60%,70%,80%,90% of total acreage in years 1 through 6; Immediate adoption involves no-tilling 100% of total acreage in years 1 through 6. LF is a large farm of 3000 ac, SF is a small farm of 800 ac. The numbers 80 and 20 refer to the percent of cropland owned outright as opposed to rented. In the first column, P is Purchase, R is rent and C is custom hire no-till drill. P-6 means purchased for all six years; R-1 means rent in year 1, then purchase for remaining years; C-4 means custom hire for four years, then purchase for remaining years; and similarly for other codes.

Table 5. Simulated probability of no-till transition failure due to a negative cumulative cash flow balance at the end of the six-year transition period for a WW-SB-pea rotation in the eastern Palouse

	Immediate adoption				Moderate adoption				Gradual adoption			
Sequence	LF80	LF20	SF80	SF20	LF80	LF20	SF80	SF20	LF80	LF20	SF80	SF20
P-6	0.03	0.48	0.28	0.91	0.01	0.34	0.17	0.83	0.01	0.25	0.11	0.67
R-1	0.03	0.53	0.35	0.94	0.01	0.34	0.20	0.86	0.01	0.23	0.12	0.69
R-2	0.04	0.58	0.33	0.94	0.01	0.34	0.16	0.83	0.01	0.22	0.09	0.65
R-3	0.04	0.63	0.32	0.93	0.01	0.36	0.15	0.80	0.01	0.21	0.07	0.59
R-4	0.06	0.65	0.29	0.92	0.01	0.37	0.13	0.76	0.01	0.20	0.05	0.54
R-5	0.06	0.67	0.28	0.91	0.01	0.40	0.11	0.73	0.01	0.19	0.04	0.49
R-6	0.07	0.67	0.23	0.87	0.01	0.42	0.10	0.66	0.01	0.17	0.02	0.39
C-1	0.04	0.57	0.37	0.96	0.01	0.34	0.20	0.86	0.01	0.23	0.12	0.69
C-2	0.04	0.63	0.37	0.96	0.01	0.36	0.18	0.84	0.01	0.22	0.09	0.65
C-3	0.06	0.67	0.37	0.96	0.01	0.39	0.16	0.82	0.01	0.21	0.07	0.60
C-4	0.09	0.71	0.37	0.96	0.02	0.44	0.15	0.80	0.01	0.21	0.05	0.55
C-5	0.11	0.76	0.36	0.95	0.02	0.48	0.14	0.79	0.01	0.21	0.04	0.50
C-6	0.12	0.78	0.32	0.93	0.03	0.51	0.11	0.74	0.01	0.19	0.03	0.40

Note: Same footnote as Table 1.

The 39 no-till transition strategies in Tables 4 and 5 represent combinations between three speeds of adoption of no-till over the six year period and the manner and 13 sequences in which a no-till drill is acquired via custom hiring, renting, and purchasing over the period. The exact definitions of the strategies are explained in the footnote accompanying Table 4. As expected, Table 5 shows lower probabilities of no-till transition failure than Table 4. The reason is that Table 5 employs a more lenient definition of failure, or more tolerance for bad economic results, than does Table 4. However, the pattern of risk results is similar between Tables 4 and 5. Strategies or farm types that are high risk in Table 4 are also high risk in Table 5.

In the following discussion, we will emphasize the results from Table 4, but as noted above the general pattern of conclusions extends to Table 5. Only highlights from the extensive tabular results are presented. Results reveal that gradual adoption of no-till, graduating up to 30% of acreage in no-till after six years, was least risky when no-till began with a 10% yield penalty. For large farms with 80% of their land owned the probability of investment failure (defined as failing to meet debt and family living payments two years in a row) was only 9-11 % for all drill acquisition options (Table 4). In contrast, large farms with only 20% of their land owned could incur a risk of investment failure of 41-44% over all options even with gradual adoption. Immediate adoption of no-till (100% of acres in year 1) elevated risk of investment failure to 18-33% for high equity large farms and 57-79% for low equity large farms (Table 4). Interestingly, immediate purchase of a no-till drill was less risky than custom or rental options for the large farms which immediately converted to no-till. The reason is that economies of scale made purchase cheaper than custom or rental. In contrast, high equity small farms could cut risk of investment failure from 35% to 20% by custom hiring no-till drill services versus purchasing a drill at the outset when no-till was gradually adopted. When these small farms adopted no-till immediately, the probability of investment failure was about the same for purchase, rental, and custom options. Overall, risks of investment failure were higher for small than large farms under our assumptions of equivalent yields for the two groups.

What generalizations and recommendations do the risk modeling results permit under the assumption that no-till has a gradually disappearing yield penalty?

1. Regardless of farm type, speed of adoption has a larger effect on navigating the no-till transition successfully than does the drill acquisition method. If you are still learning to make no-till work, go slow in acreage expansion.
2. Higher equity farmers, without the drain of rental payments to landlords, have a higher probability of no-till transition success.
3. If large farmers have the cash or financing, rapid purchase of a no-till drill has a reasonable chance of success; however, gradual or moderate acreage expansion is still recommended until any yield penalty is eliminated.
4. Low equity farmers have the lowest probability of successfully navigating the no-till transition while financing a drill. Small low equity farmers are at greatest risk. Farmers renting a high proportion of their cropland may want to wait until they can pay cash for a (possibly lower cost) no-till drill. This is the consistent with the experience of the renting transition growers whose results are reported in Table 3.
5. Custom and rental drill acquisition in early years of the transition is recommended for small farmers, especially if they are expanding no-till acreage gradually.

<u>Objective 2. To disseminate results.</u>

Research results identifying factors associated with adoption of no-till and the no-till transition process were presented to growers and scientists in several of WSU's field day proceedings. Results on factors associated with no-till adoption, on no-till and fallow reduction in North America, and on the experimental design of conservation tillage field experiments were published in professional journals. We presented results on the economics of weed control in conservation tillage systems to three local and international groups. Results were also presented at field days for the Ralston and Lind projects, at other farm groups, and at annual meetings for these projects and the Columbia Plateau Air Quality Project. D.Young will present the results of this research at the Direct Seed Meetings in Pasco, WA in January 2003. Co-PI's of the project are the sole social science participants in the conservation farming systems group at Washington State University. Young is a member of the State Advisory Committee for the Natural Resources Conservation Service (NRCS) in Washington state where he has been able to communicate research findings to NRCS on a regular basis.

INTERACTION (COOPERATION) WITH OTHER SCIENTISTS CONDUCTING RELATED ACTIVITY: We sought advice from WSU Crop and Soil Sciences faculty, USDA-ARS scientists, and NRCS personnel listed as Cooperators above in the selection of no-till farmers for case studies and surveys. John Burns, WSU-Extension and Dennis Roe, NRCS, were particularly helpful in suggesting no-till growers. Project cooperators also have provided data on no-till yield levels, yield variability, and input requirements. Drs. Bill Schillinger and Frank Young have been especially helpful in providing data from their long run no-till and min-till cropping systems at Lind and Ralston in Adams County. We have also conferred with Dr. Larry van Tassel, U. Idaho, and Drs. Herb Hinman and Gayle Willett, WSU on procedures for incorporating time and uncertainty into the profitable acquisition on no-till drills. Dr. James

Richardson, Texas A&M University has provided software and valuable advice for modeling the economic risk of no-till equipment acquisition over time.

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